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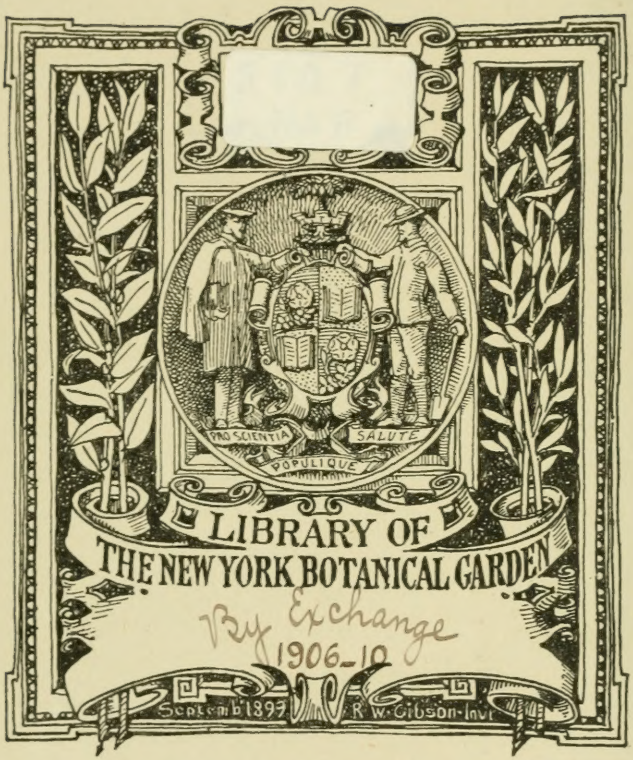
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REPORT

OF THE

BOTANICAL DEPARTMENT

OF THE

New Jersey
Agricultural College Experiment Station,

New Brunswick, N. J.,

BY

BYRON D. HALSTED, Sc.D.,

For the Year 1906.

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TRENTON, N. J.:
The John L. Murphy Publishing Company, Printers.
1907.

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REPORT OF THE BOTANIST.

REPORT OF THE BOTANIST.

BYRON D. HALSTED, SC.D.

EARLE J. OWEN, B.S., ASSISTANT.

During the passing year the work of the Botanical Department has been chiefly that of plant improvement by breeding and selection among truck plants. Alphabetically, the list of subjects receiving the most attention is: Beans, corn (sweet and pop), eggplants, squashes and tomatoes, while, in a small way, a place has been made for martynias, okra, onions, peas, peppers, salsify and udo, to which the "Prairie Huckleberry" and several strains of "Chinese Cabbage" may be added as "novelties."

With beans, the work thus far accomplished gives hope for the securing of a stringless snap variety, with fleshy pods, bearing small white seeds. Aside from the above desirable qualities, a high degree of productiveness is sought for rather than extreme earliness. The number of crosses already secured is large and, with some of them, the fifth generation is past and a fair degree of fixity secured. By means of the greenhouse, a generation is gained, and with the midsummer planting three crops are secured in a year. Among the lima beans many crosses have been made that may help in bringing this highly-prized vegetable more nearly to perfection. On account of the prevalence of the mildew, which is favored by the surrounding dense, often moist, foliage, efforts are being made to secure desirable types of seeds that are associated with the "willow-leaf" form of foliage and, also, more length of flowering stem that the pods may be formed in the open above the leaves. The hybrids of the bush beans and "Scarlet Runner" have been grown another year, and some of the offspring show decided productiveness with the dwarf nature and may develop into a strain of beans of much value. These hybrids are likewise not without interest from the standpoint of the breeder, as the work gives an insight into the natures of the subjects and the possibilities that may be hoped for along other lines of breeding.

As large a number (twenty-five) of blocks of cross-bred sweet corn as possible have been grown upon the three acres included in the Gardens in addition to which as many more throughout the State through the co-operation of growers of truck crops. Perhaps the results that are most deserving of notice are the "Malamo" and "Malako-by" varieties, seeds of which are to be offered under their respective names the coming spring. They both have the "Malakhov" as the male parent, from which great speed with no apparent loss of desirable qualities is secured. Both sorts have been extensively tested throughout the State during the past season, and upon the Home Grounds they were closely studied and gave satisfactory results. A large number of other crosses are adding a generation to their history, and the notes show that some are meritorious and deserve further attention. A greater length of grain in medium-season, main crop varieties is sought for by breeding the "Country Gentlemen" and "Stowell's," for example, with early sorts. The effect of breeding pop and field with sweet corns is being studied and, also, the correlations of special colors in tassel, silk, cob, husk, etc., to desired qualities of plant and its product.

The year's work in breeding eggplants has brought some results of immediate value to the truckers in a desirable new strain, having a long, bell-shaped fruit that is pink upon the exterior and of a very pleasing white within, the flesh suggesting that of the "Snow" apple. A white-fruited kind has also been secured that, when grown in sufficient quantity, may be offered as the "Ivory" eggplant. From a scientific standpoint, some results have been obtained in the hybridizing of the "American" and "Chinese" species that, it is hoped, may throw light upon the question of dwarfage and fruitfulness, not to exclude spinoseness in eggplants.

The work with squashes is along two lines, namely, the summer varieties and the winter sorts. One of the attempts with the first is to get a specially early and prolific variety and some promise is met with here. Another problem is to add to the present types another that is neither flat ("pattypan") nor long "crook-necked," but broad-fruited with a short, straight neck which, for lack of a better name, has been temporarily dubbed the "jug." It is to be free from warts and of a white, cream or orange, as may be desired. It has been found that fruits secured by breeding within the crossed plant give offspring that are sufficiently close to the mother type to inspire hope that almost any form in a summer squash may be secured. The ease with which the surface irregularities (warts, etc.) may be eliminated is likewise interesting if not surprising. With the vine squashes there is a large field for improvement and one with many inherent difficulties, but with a suitable rich soil—nowhere more important than here—and plenty of it, one need not be discouraged. During the present season several crosses were developed, some of which show much of promise. The combination of the "American" and "Japanese" has given fruits that, while in themselves are unimportant, may be a step toward desirable combinations. In the same way other hybrids obtained between American species may bring direct good after much further breeding.

With tomatoes the lines of work are being centered somewhat upon a longer fruit of the large type, not the "pear," drawn out and enlarged, but a "goose egg" with the interior filled with flesh having many very small seed cavities. In this quest the lack of an ideal tomato of the ordinary type is not overlooked, and, out of the hundreds of combinations thus far made, there are several of especial merit—one of which, the "Marvelosa," ("Marvel" upon "Ponderosa") will be added to the list of those already developed and seeds distributed next spring. It has borne the test well during the past season.

On the secondary list of vegetables under consideration the peas show much to warrant special attention. Some of the crosses, made in the hope of getting a small, early sort adapted to the needs of the canners, are showing merit, and it is hoped, with two crops in a year, to develop a desirable sort with comparative rapidity.

During the year two bulletins, namely, No. 191, "Seed Distribution of 1904 and for 1905," and No. 192, "Breeding Sweet Corn—Co-operative Tests," have been issued by the department, the last one of which deals with certain laws of breeding determined with corn that may prove to be widely applicable to other vegetable fruits.

The seed distribution of last spring embraced 1,332 packets, as follows: Lima beans, 112; sweet corn, 329; eggplants, 267; squashes, 216, and tomatoes, 408 packets, respectively.

A branch for seed inspection has been opened and the offer is made to examine samples of clover and allied seeds as to their purity.

During the year a two-story addition has been built at the Gardens that furnishes an office and tool-room upon the first floor and space above for the many requirements in maintaining and harvesting the several crops.

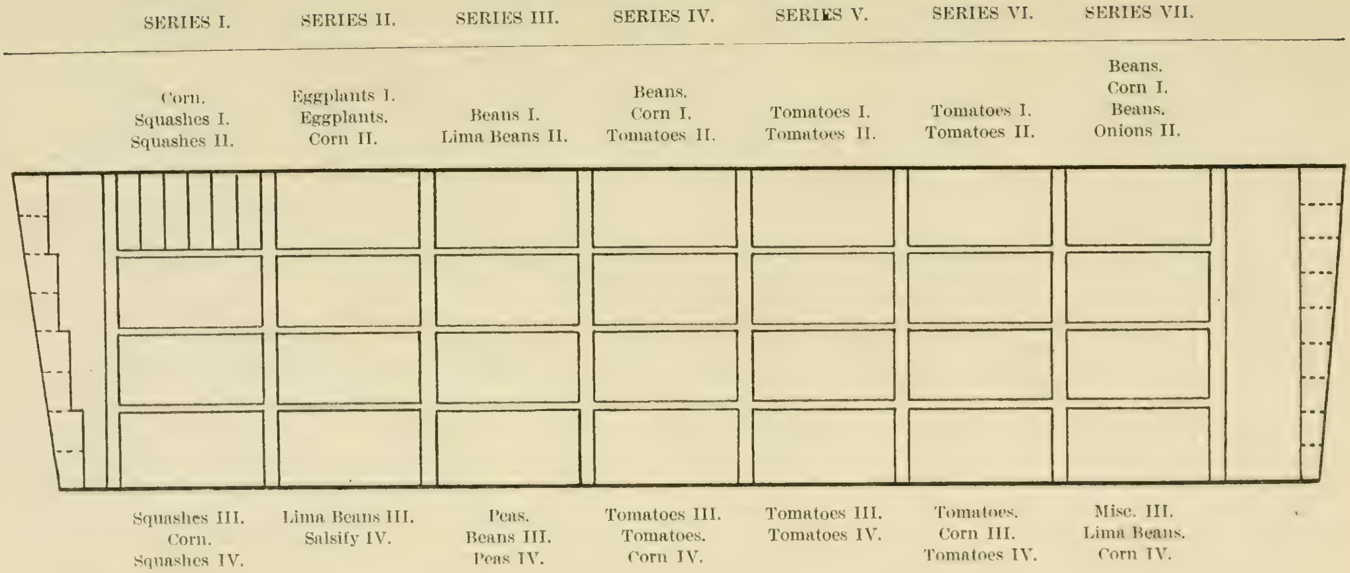
THE EXPERIMENT AREA OR GARDEN.

The plan of the Garden proper is given upon the opposite page and consists of two acres, divided into seven series with four plots to each. Paths separate the series and others running lengthwise of the grounds complete the approach to all sides of each plot. There is an irregular block of ground at each end of the rectangular plots, as shown in the plan, and these are occupied with ornamental plants and grass experiments.

The soil is fairly uniform in quality, it being a mixture of clay and gravel, and at the outset was not of the best for garden purposes, but its texture has been much improved by the annual application of manure at the rate of twenty tons per acre for the past twelve years.

In addition to the above area, one acre, in three long and widely-separated strips in an adjoining field, has been used for the past two years. Upon this "new land" several of the corn-breeding plots were located, and, between them, crossed beans and squashes have been grown. The soil of this recent addition to the College Farm is far from satisfactory for the best work in breeding where a rich deep soil is a prime requisite, but it may be improved from year to year.

The Experiment Area for 1906.


SERIES I.
SERIES II.
SERIES III.
SERIES IV.
SERIES V.
SERIES VI.
SERIES VII.
Corn.
Squashes I.
Squashes II.
Eggplants I.
Eggplants.
Corn II.
Beans I.
Lima Beans II.
Beans.
Corn I.
Tomatoes II.
Tomatoes I.
Tomatoes II.
Tomatoes I.
Tomatoes II.
Beans.
Corn I.
Beans.
Onions II.
Squashes III.
Corn.
Squashes IV.
Lima Beans III.
Salsify IV.
Peas.
Beans III.
Peas IV.
Tomatoes III.
Tomatoes.
Corn IV.
Tomatoes III.
Tomatoes IV.
Tomatoes.
Corn III.
Tomatoes IV.
Misc. III.
Lima Beans.
Corn IV.

EXPERIMENTS WITH SWEET CORN.

Fourteen blocks of cross-bred sweet corn were grown upon the two acres of the Garden proper, care being taken to plant alongside of each other the early and late-blooming crosses in such a manner as to prevent inter-breeding. The earliest kinds were planted first and near opposite ends of the Garden.

"Malakhov-Premo"—"Malamo."

A block of forty-two (6 by 7) hills of "Malamo" sweet corn was planted in series II. upon April 25th, and a second patch of forty (5 by 8) hills upon April 30th. The weather conditions for early growth were so unfavorable that these two lots of corn appeared the same in all respects throughout the season and are treated as one. The results here and elsewhere lead to the opinion that the growth period of sweet corn depends largely upon the time when the seed is planted. In other words, corn planted upon May 15th will yield table ears in much shorter time than when planted three weeks earlier. In this particular case, one block gave table ears in seventy-six and the other in seventy-one days, and, had there been a third and later planting, the time probably would have been still more shortened.

The tagging of the stalks began with the first appearance of the tip of the tassel upon June 20th and closed upon July 2d, a period of bloom of nearly two weeks. The tassels, usually tinged with pink, were occasionally green, and the silk (which came two or three days later than the tassel) varied from red through pink to green. The green tassel was associated with green silk, that is, the color when present showed itself throughout the plant, the stalk being sometimes tinged with purple. The "Premo" parent shows similar range of color in the plants.

The stalks varied somewhat in size, there being a few of the small, slender type of the "Malakhov," and these, usually among the first to bloom, were regarded as undesirable and at once discarded. The majority of the plants averaged five feet and some reached the height of six feet. A set of measurements was taken upon the growth of stalks, after the tassel showed its tip, with the following results:

DATE.	HEIGHT.	DATE.	HEIGHT.
June 22	3 ft. 6 in.	June 28	5 ft. 1 in.
" 23	4 " 0 "	" 29	5 " 2 "
" 24	4 " 5 "	" 30	5 " 3 "
" 25	4 " 8 "	July 1	5 " 3½ "
" 26	4 " 10 "	" 2	5 " 4 "
" 27	5 " 0 "		

At the first hoeing all suckers were removed from the plants in alternate rows and this desuckering was continued through the season. Upon the other rows the suckers were detasseled as they neared blooming.

A block of corn that seems short as the tassels appear will grow up to a good height in the next two weeks, during which time the blossoms have come and the ear been impregnated. The corn was studied daily and certain plants were marked with a white tag. Those showing the most vigor, indicated by size of stalk and leaves, and having one or more acceptable ears set well up from the ground, were marked and the tassel removed to prevent inbreeding. Notes were made upon the tag of the earliness, color of silk and any special point that might be of value when the final selection of seed was made.

Upon August 1st the mature plants, having lost all the green color, were pulled up and laid in a row from which the stalks with two good ears were selected. From this lot the stalks with the pairs of ears nearly of the same size, and borne well up from the ground, without suckers, were laid aside. After the ears were husked from these, the pairs of best shape—cylindrical and well filled out at the ends—with more than eight rows of fine grains, were selected.

A set of forty-three ears of the "Malamo" sweet corn is shown at 1 in Plate I. The ears are somewhat taper-pointed and vary in rows of grains from eight to twelve. Those shown upon the drying pole* are chiefly more than eight-rowed and will furnish the seed for the first portion of the distribution. The grains are of a desirable length and the various qualities of this sweet corn are given below in the language of those who have made a practical test of it during the year.

---

* The dryer consists of a fence picket through which nails are driven at regular intervals upon the four sides. By bending the nail tips upward, the ears may be securely held in place by pushing the butt ends down upon the nails, as clearly shown in the engraving. These holders, when fitted with a hook at the upper end, may be suspended quite close to each other in an airy room and provide the conditions for a satisfactory curing of each ear, free from all contact with others.

Reports from Testers of the "Malamo."

There were seventy-six packets of the "Malamo" distributed to those requesting it, and the following quotations separate the remarks in various individual reports: "Corn was fine; ears of nice length and corn sweet and fine flavor." "Corn was fine; so sweet, we think, we never had better corn, so early in eighty days it was fit to be used. The ears were a nice size, the grains were fine all the way out to the end of the ear." "Planted corn in choice ground with Mapes fertilizer and gave it a fair chance and good attention and was given fine table ears in seventy-two days. I will say it is the earliest and sweetest corn I ever raised from any seed I have ever had sent me from any Agricultural Experiment Station. I am sure yours takes the lead." "Corn was well matured and of fine flavor. Pronounced by epicures to be the best earliest variety known." "Has proved an elegant early variety." "Corn in fine condition, four feet to five and a half feet high, just silking out." "Is very promising, stands hot dry weather unusually well; very even in size, height and appearance." "Looks healthy and vigorous." "Have fine table ears, two ears to the stalk. It is the most satisfactory small corn I have found." "Find corn very nice, tender and very sweet. Growth not large, but ears quite large and abundant. Hens seem to prefer it to all other kinds." "Corn is early and sweet." "Abundance of ears for table use in sixty-five days from planting." "Practically every stalk has two good ears, some more. We consider the quality very fine." "A valuable variety." "As forward as any corn we have." "Corn was very fine sixty-seven days from time of planting." "Has given entire satisfaction; grew in much less time than we were expecting." "A very fine table corn and a great yielder; average yield two and a quarter ears to stalk." "Ears forming forty-two days after planting." "I consider it one of the best extra early sorts." "Is an improvement on the 'Malakhov,' being larger both in stalk and ear and but a few days later in maturing." "'Malakhov-Premo' gave me table ears in sixty-nine days and it looks like

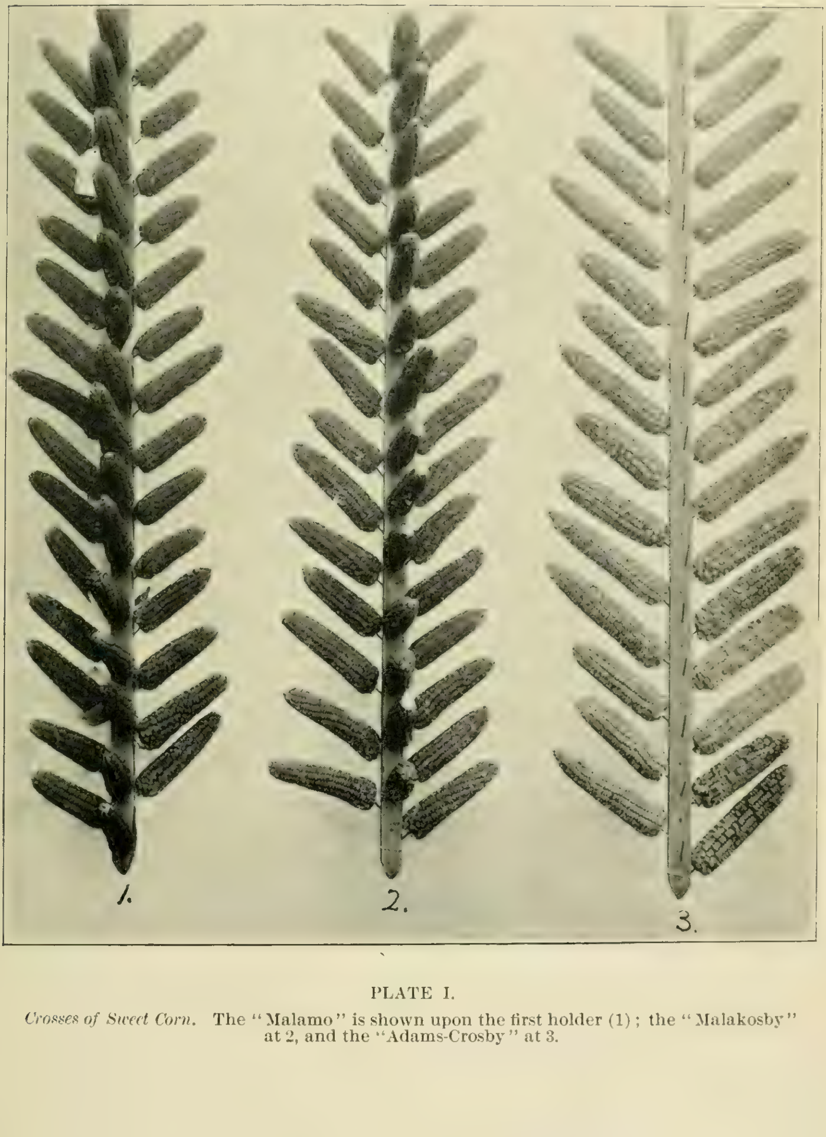


PLATE I.

Crosses of Sweet Corn. The "Malamo" is shown upon the first holder (1); the "Malakosby" at 2, and the "Adams-Crosby" at 3.

a very promising variety for early; two to three ears to a stalk and good eating quality." "It is fine, two ears to a stalk and a rank grower. It is the earliest sweet corn I have ever had." "It is the earliest I have had and the nicest." "The corn is a good cropper as each stalk has two ears." "I planted the 'Malakhov-Premo' corn on the 21st of April and had corn ready for the table on the 4th of July. Am much pleased with it." "Corn has already been tested by my family, only sixty-eight days planted and eaten. I think very much of it." "Should prove a useful early commercial table corn." "Is earlier than any variety we ever planted." "Ears were well filled." "Appears very productive." "Every grain sprouted and grew rapidly; it is a sweet and desirable early corn." "Has done nicely and given good satisfaction. Stalks small but mostly give two fair-sized ears, well formed and filled out with kernels to the point. Quality good." "It is fine—two ears to a stalk and a rank grower. It is the earliest sweet corn I have ever had and I have tried several kinds." "Good-sized stalks, seven feet high and fair-sized ears, seven inches long with eight to twelve rows of kernels. Good quality. 'Malakhov' (pure) is, undoubtedly, the earliest sweet corn but too small for market. 'Malamo' is nearly as early (within four or five days) and all right to sell."

"Malakhov-Crosby"—"Malakosby."

The fifty hills of the cross of "Malakhov" upon "Crosby" were planted May 15th. The stand was very satisfactory and the plants were stout-stemmed, bearing green broad leaves and giving an appearance, before the tassels came, quite different from the "Malamo." Suckers developed in nearly every hill and were removed from a half of the plants in alternate rows. This removal changed the appearance of the hills and the two rows, from which the suckers were removed, were somewhat earlier in maturing their ears. The suckers that were permitted to remain were all detasseled as they approached the time of blooming, so as to prevent any fertilization from these earless stalks.

The ears upon this variety were set low upon the stalks, and, when forming, were with long, slender, leafy tips supplementing the tendency to excess of foliage elsewhere. Upon July 23d, fine large ears were gathered for the table, sixty-nine days from the time of planting. The crop began to ripen upon September 4th, when the earliest ears were gathered for seed. From the holder at 2. in Plate I., the general character of the ears of this cross may be gained. They are somewhat larger than those of the "Malamo," shown at 1. and are more uniformly twelve-rowed. There were many twins and these will furnish seed for a special experiment in selecting for large yield.

Reports from Testers of the "Malakosby."

Seventeen packets of this cross were distributed last spring, and from the reports the following remarks are extracted: " 'Malakhov-Crosby' corn did well for me; I planted it close in good soil and almost every stalk produced one or more good ears. Quality very good. Stalks from four and a half feet to six feet high and an inch to an inch and a quarter in diameter. It was well developed and fit for eating before other varieties." "The ear is of good size and quality of corn good." "The ears were about six inches long with twelve rows of pure white grains, which were as sweet as any corn I have ever eaten." "The quality being very good, we are very much pleased with it; the season here has not been the most favorable for corn." "It is very early; in sixty days was large enough to pull." "As far as our experience goes, it is a distinct variety, such as some seedsmen would take pages to describe. We planted part of the seed about May 5th, the rest ten days later. The first was ripe about July 16th, came so quickly we pulled none until the 20th, when it was a little too old to be at its best for the table. Have had two neighbors sample a few ears, and they both, and ourselves, pronounce it very good-flavored and sweet. Height of plant five and a half to six feet to top of tassel. Ears two to a stalk, borne very low down, some only six to eight inches from the ground. Ears long for size of stalk, grains large and regularly placed and ear makes a good appearance when cooked; very desirable for the home garden." "I planted April 20th the seed received from you and had fully-matured corn for the table on July 4th, seventy-five days from time of planting. Would have done very well for eating, I think, a couple of days sooner.

The ears, some of them, were well developed and good size. Got one ear seven inches long and as well developed as anyone could wish for. I showed it to several and they were all greatly surprised. I think it a grand acquisition to the list of early corns." "The 'Malakhov-Crosby' corn was planted May 4th, was fit for the table July 14th. Plant is medium size, very thrifty grower, does not sucker as badly as 'Crosby' nor smut like 'Malakhov.' Ears nice size and very symmetrical, averaging two on a stalk. Quality all that could be desired. For home or market, it is the best early corn I ever grew." "I have to report most satisfactory results from 'Malakhov-Crosby' sweet corn. Corn is excellent indeed and of fine flavor. I planted on the 12th of May, had it on table on July 10th; fifty-nine days gave me fine, mature corn for table use. Am delighted with results." "The corn is all right, the stalks grew about four feet high, the ears about seven inches, the quality sweet and fine. Fit for table in seventy-two days."

The "Adams-Crosby" Cross.

A block of thirty hills of a cross of "Adams" upon "Crosby" was planted April 25th and produced a fine stand of stout stalks, bearing heavy foliage and but few suckers, the latter being removed while young from half the hills. Upon July 12th it was noted that the stalks averaged seven feet in height and the block was one of great vigor. The tassels varied from purple to pink and some of the silks were green but mostly purple. There were frequently two ears to a stalk and these were borne three feet or more from the ground. Upon July 24th, ninety days after planting, ears were used for the table and were of fine size and fair quality. Maturing began upon September 4th and an early picking was made for the sake of planting to increase the earliness by selection.

The appearance of the ears of this cross is well shown at 3 in Plate I. In size this cross produces a much larger ear than the other two crosses shown in the engraving, and is a broad, cylindrical form with the oval end generally closely filled with good grains. The rows are usually twelve and the kernels rather broad.

As expected, this first generation after the blend shows at maturity that the grains are three-fourths of the starchy type and one-fourth sweet and wrinkled. The difference is so marked that it is shown in the various ears as seen in the plate. A student counted the shelled grains from ten average ears, with the result that 3,267 were flint and 1,103 wrinkled, thus giving 74.8 per cent. of flints, or within two-tenths of a per cent. of the theoretical amount. The range of percentages among the ears was from 68.4 to 78.1. The flint and wrinkled grains (4,370) of the above ten ears were very thoroughly mixed together and divided into ten practically equal lots. These, when separated into the two types, showed a range of from 70.0 to 78.8. In other words, the mixing in nature approximated that done intentionally by man. According to theory, the sweet grains (when planted in isolation) will produce ears with the grains all sweet, and, therefore, it is intended thus to plant a block upon the Home Grounds and offer packets for testing to those who may be pleased to grow it. It is hoped to get, in this way, a sweet corn with much of the vigor of the "Adams" combined with the fine qualities of the "Crosby."

THE "MEXICAN-GENTLEMAN" CROSSES.

The crosses here considered were made in 1903, have been grown for the last three years, and a record for each successive season has been given in previous reports.

Of the cross of "Country Gentleman" upon "Black Mexican" (19/99) the grains selected for the last season were from straight-rowed ears and they made an even block of plants, above the average in height, bearing the medium-sized ears high from the ground. The yield was not large but the quality was fine. At harvest time thirty-six good ears were secured, thirty-one of which were straight-rowed and only five partially zigzag, the irregularly placed grains being in the upper half of the ear. The ears were all solid white, so that, in this case, the dark "blood" of the cross probably is not present.

The reciprocal of the above, namely, the "Mexican" upon the "Country Gentleman" (99/19), also three years from the cross was likewise grown in a block of thirty hills and produced plants of the same type. White grains only were planted and the crop was entirely free from dark grains. The ears were medium-sized and borne high upon the stalks, and of the twenty-six, gathered upon September 8th, eleven were entirely straight-rowed and fifteen showed the zigzag type in a greater or less degree.

Two blocks of corn, above noted, were so much alike in all details that they might have been easily considered as from grains of the same uniform packet of seed.

Below are given some of the remarks made in the reports of those who tested the above crosses throughout the State.

"Mexican-Gentleman" (Solid Black Grains).

From this lot of seed twenty-five packets of kernels were distributed to those requesting the same, and from the reports the following remarks are extracted: "Stalk and ears rather short, vigor fairly good, productiveness as good as any." "Very good size and very good quality and produced a good many ears of nice even grains with all black color when ripe." "Will say that it is all that it is claimed to be, an early, sweet, tender corn. Vigorous grower, grains uniform, an excellent bearer and I would think it an excellent, early corn for market, a very thrifty grower." "Was planted early, made a rank growth to about five feet and eared about an average of two ears to stalk; ears were well filled, not very large but best shape of any early corn I had and very free from worms." "My crop averaged four feet and six inches in height, two full-grown ears to a stalk, some ears entirely dark, others mixed, very sweet, good for home use." "Did finely, plants of medium height, all bearing two, some three, large ears, quality delicious." "Grew remarkably well, bore nice, plump ears well filled out, matured very early. A good, early productive variety, grains uniform and compact."

"Mexican-Gentleman" (White Zigzag Grains).

Sixty-four testers received the above corn and reported as follows: "Every stalk produced about two good ears, the grains were all uniform in size and a very sweet flavor, ears good size, stalks were hearty and averaged about five feet high and ripened very evenly." "Small, tender kernel, stalks eight feet high, vigorous, eighty-seven ears to about a dozen hills." "Plants made an unusually stocky and quick growth from the very start, of an elegant dark green color and nearly every one bore two full-sized ears averaging almost nine inches in length, thoroughly filled to the very tip with deep, even-sized grains throughout and possessing a superior sweetness not found in any other white sweet corn; would consider it very valuable." "This developed the best stalk and ear of any variety sent me for trial. A very fine quality." "Vigorous and productive." "Green corn very similar to 'Country Gentleman' but of stronger growth and more productive, ears a trifle larger, quality good." "It was very good size and yielded well." "Very good." "Very vigorous and productive and a large stalk." "It is a very promising variety." "It was unusually productive, much more so than corn I planted last year." "Found it a very sweet corn, grains very deep set and very compact, a most excellent bearer and thrifty grower, ready for the table early and would think it an excellent corn for truckers." "Is very good." "Very vigorous and productive, quality the best of any raised this year." "Quite productive." "I regard my test as a great success; it was very productive, ears were large for sweet corn, grains very fine and the general uniformity of the ears was all that could be desired in a sweet corn." "Corn was excellent, length of ears eight and a half and nine inches, diameter six inches. As productive as good corn usually is." "Plants grew five and a half to six and a half feet tall, well covered with leaves, generally two ears to the stalk, grains were very white and sweet. Grains were long and remained in an edible condition for a long time." "This would make a fair variety for early field culture."

"Mexican-Gentleman" (White Straight-rowed Grains).

This strain of the cross was sent to fifty-six persons who selected it and reported as follows: "Corn was of excellent quality." "Very sweet and good flavor." "Quality good and sweet, grains white in green state." "Tall plants, very vigorous, good flavor, I think a very good variety." "Good grower and one to two ears on every stalk, very large cob." "Good growth. I think with another year's selection you will get all ears perfect. Good quality." "Vigorous and productive, color good and satisfactory grains and ears; am well pleased." "Seed has produced a very fine crop of ears; I find the variety a productive one on our soil, ears well filled with good-sized kernels, very sweet and prolific, a very profitable one for the market gardens to grow." "Ears of this corn came up well. Some of the straight-rowed had very large kernels and were very tender." "Would say I found it an excellent early corn, several days earlier than other kinds and very sweet and tender, an excellent good grower and also a good bearer." "Strong and vigorous, two or three ears on each stalk, ears about eight inches long, flavor good." "Would consider it a very good variety."

OTHER "BLACK MEXICAN" CROSSES UPON HOME GROUNDS.

The following is a list of the crosses of the "Black Mexican" upon other varieties of sweet corn that were grown in the Garden during the past year, namely: "Banana" (6), "Gold Coin Evergreen" (26), "Striped Evergreen" (27), "Metropolitan" (56), "Perry's Hybrid" (66), "Potter's Excelsior" (69), "Quincy Market" (74), "Triumph" (88), "Garwood" (94) and "Malakhov" (95). This was the second generation, and, in all instances, grains appearing to be pure white were selected for planting the hills (usually thirty to forty-five) devoted to each cross.

"Mexican-Banana" (99/6).—This block, planted upon May 14th, made an evenly tall and slender set of stalks with large tassels, with pink anthers followed by silks that varied somewhat in their pink color. The small ears, borne high upon the stalk, were of high quality. Of the sixty-two ears harvested upon September 5th, some contained a majority of dark grains, suggesting that the mother kernels for these, although white to the eye when the seed corn was selected, probably contained dark "blood." The fact that all the other fifty-five ears contained a small percentage of dark grains is probably due to the pollen from the seven plants that bore the dark ears above mentioned. Thirty-three ears were straight-rowed, nine with the grains zigzag, and twenty showed a combination of the two types of grain arrangement. There is a suggestion here of the straight-rowed being dominant over the zigzag type.

"Mexican-Gold Coin Evergreen" (99/26).—This block was purposely not planted until June 26th, that it might escape mixing

with its near corn neighbor, an earlier maturing cross planted seventeen days earlier. The plants were large and stout, bearing green tassels and silks, followed by large, broad ears borne high upon the stalks. The cross retained much of the "Evergreen" type throughout and the grains had nearly the length of those of "Stowell's," and there is hope that this will make an acceptable mid-season variety. One ear had a preponderance of dark grains, suggesting that the attempt to eliminate the "black blood" failed in one instance, and, as a result, all the ears showed a small percentage of dark grains.

"*Mexican-Striped Evergreen*" (99/27).—This is a peculiar cross because the "Evergreen" has a color character that is deeper-seated than the grain, that is, the ears vary in the amount of red markings and are units in this respect. Sometimes an ear is solid red, including the cob, while another is of the ordinary white type, while others have all the grains alike, striped. The block of forty-five hills, grown the present season, was from white grains of the cross and from an ear with a white cob. Of the fifty-eight ears harvested, four were with a majority of the grains black, showing that the seeds planted carried the dark blood of the "Mexican;" one ear was solid red and one with all its grains striped. It is interesting to note that two grains, neither of them showing any of the red color, developed plants, one of which produced a solid red ear and the other one that combined the red and white to make the genuine striped type. It was also observed that two ears were with their grains manifestly zigzag. It is, of course, possible that this may have resulted from a mixing with the previous season with some of the zigzag sorts.

"*Mexican-Metropolitan*" (99/56).—This was a block purposely planted late, but reaching maturity and making a large growth of stalks and ears of a desirable type, usually twelve-rowed, and grains of fair length. There was a small percentage of dark grains, owing to the presence of a kernel in the seed that evidently was not pure white.

"*Mexican-Perry's Hybrid*" (99/66).—Here, again, the planting was late (June 26th), but the long season permitted the crop to mature. Of the thirty ears gathered for seed September 12th, one showed that there was dark blood in the grain planted and all the others showed some black kernels. The ears are of fair size and of handsome shape, being twelve-rowed, with the grains of good depth. One ear had pinkish kernels and cob.

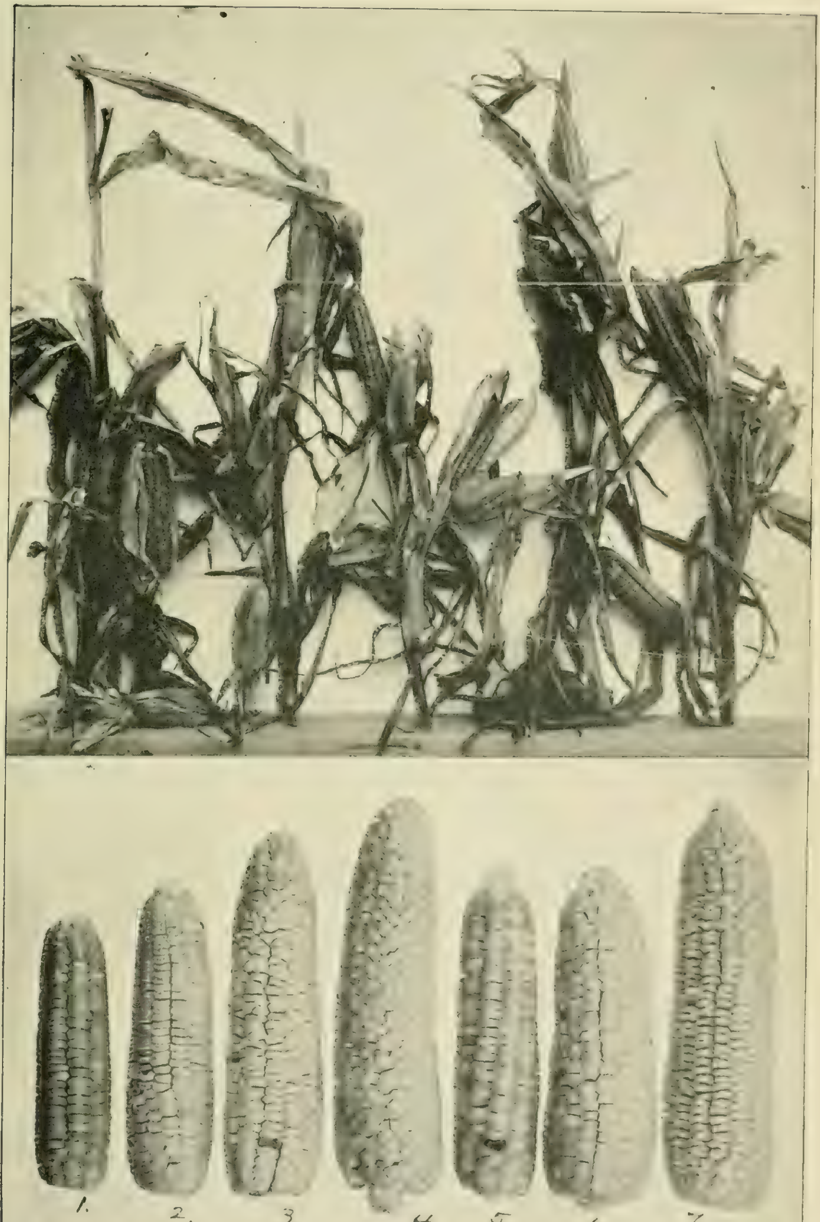


PLATE II.

Crosses of Sweet Corn. The central portions of stalks with ears of the "Mexican-Quincy Market" are shown in the upper part. Below are sample ears of the "Bantam-Gentleman" cross at 2 and 3, and of the "Bantam-Stowell's" at 5 and 6, with the parents at ends (1 and 7) and middle (4) of the row.

"*Mexican-Potter's Excelsior*" (99/69).—The block of ground given to this cross was of the poorest upon the New Land, and being planted late (June 26th) the results were meagre.

"*Mexican-Quincy Market*" (99/74).—This cross was planted June 9th and made a block easily recognized by its abundant suckers, and later, because of the strong tendency to form twin and triplet ears. A photograph of the fruit-bearing portion of five of the stalks was taken and are shown in the upper part of Plate II. The ears are long, slender and usually eight-rowed. A test of the table quality was overlooked until the ears were too mature. At harvest time seventy-seven good ears were gathered, seventy-one of which had white and six pink cobs. There were six plants that showed, by their much-mixed ears, that the parent grains bore dark "blood," and this caused a general slight mixing of the whole crop.

"*Mexican-Triumph*" (99/88).—This cross was planted late (June 26th), upon poor soil, and only seventeen good-sized ears were secured, all eight-rowed. Four showed a half or more of dark grains and one of them was quite flat, with the two belts of four rows each separated from each other.

"*Mexican-Garwood*" (99/94).—There were thirty hills of this cross planted late (June 26th) to escape mixing with the "Mexican-Malakhov" cross grown near by. The crop was ripe October 8th and before any frost had come. The harvest was a good one and the quality superior. Nineteen of the fifty-nine of the best ears that were harvested showed a large percentage of dark grains and forty had only a few dark kernels. While all visible precautions were taken to select pure white grains for planting, it seems evident that practically one-third of them carried dark "blood." Of these nineteen that were with half and more of dark grains eight were with eight rows of kernels like the "Mexican" type, while of the forty which were from pure white "blood," but crossed upon by the dark pollen of neighboring plants the present season, there were only eight ears of the "Mexican" type. In other words, there was a larger percentage of the "Garwood" type among the white ears than among the ears that were evidently from mixed seed.

"*Mexican-Malakhov*" (99/95).—This block was planted May 14th and made a fine stand of medium-sized plants, which bore straw-colored tassels and green silks, occasionally tinged with pink. The time when ears were taken for testing upon the table was not recorded, but the first ripe ears for seed were gathered August 13th—that is, ninety-one days after planting. The final harvest was made September 28th, when sixty ears were secured, ten of which were with a majority of the grains dark and all were somewhat mixed. The plants and their ears indicate that much selection is needed to develop a sort that will be uniform in the desired qualities. There is a tendency toward flintiness in some of the grains that needs to be especially considered.

"GOLDEN BANTAM" CROSSES OF SWEET CORN.

The "Golden Bantam" (34), as might be inferred from the name, is a small variety with yellow grains, usually borne in eight rows, and has the considerable merit of maturing quite quickly. On account of its unusual color, it marks itself upon any white variety. This sort was employed as a breeder upon a long list of the leading commercial sorts in 1905, and from the crosses then secured seed was saved, from which the following results have been obtained:

"*Golden Bantam-Essex Early*" (34/29).—A block of forty-five hills of the "Golden Bantam" upon "Essex Early" was grown upon the New Land, and proved to be very early and gave a fair crop of well-shaped ears, five samples of which are shown in the upper left-hand corner of Plate III.*

The "Essex Early" is a white corn, the ears of which are usually more than eight-rowed. The cross, as grown for its first generation the present season, gives a neat, shapely ear, of sufficient size, with ten or twelve rows and of a quality to warrant its further growth and selection. From the engraving, it may be seen indistinctly that the ears have a mixture of "white" and "yellow" grains, the latter making up three-fourths of the total number, as might be expected from the Mendelian law, the yellow in the crossed grains showing to the exclusion of the white character present. In short, in each ear there are one-quarter of pure white and one-quarter pure yellow, and one-half that are half yellow and white, these latter showing as yellow.

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* This set of ears is upon a larger scale than the other three sets in the engraving.

By selecting the white grains and planting them in isolation—that is, out of reach of other corns—the white strain of the above cross would be at once established. Upon the other hand, the yellow grains, planted by themselves, would have a total of one-third of its blood of the white strain obscured by the yellow, and, in the next crop, would come to light to the extent of one grain in nine, or 11.12 per cent. of the whole.

By growing the yellow grains of the first crop from the cross in pairs far from any other corn (to prevent the weakness that would come from growing a single isolated plant), one might chance to get a pair of pure yellow plants which, when thus bred together, would give at once solid, yellow ears, free from the admixture of the white "blood."

"Golden Bantam-Premier" (34/70).—This cross is similar to the last mentioned, but with the plants stronger, of greater vigor and decidedly more productiveness. There are several points of difference which come to the surface as the crosses are watched from week to week. In the present case, the suckers were abundant and the tassels straw-colored and the silk pink or pinkish (not green), quite the opposite of the "Bantam-Essex" cross, where the tassels were red or reddish, and the silks usually green. The point that commends the "Bantam-Premier" cross is its large number of twin ears, two of which are shown in the plate near the upper right-hand corner (1 and 2) of the engraving. They are necessarily smaller than ears borne singly, a sample of which is shown upon the right (3), and closely approach the desired type for a twelve-rowed ear. The block of forty-five hills has yielded liberally and this seed is offered for testing, both of the white and the yellow grains, distributed separately.

"Golden Bantam-Banana" (34/6).—This cross is between two widely differing varieties, the "Banana" being one of the "zigzag-shoepeg" kinds (perhaps most familiarly known by the "Country Gentleman"), and from the time the plants were knee-high a great range of variation was apparent. As the weeks passed, certain stalks, still small, flowered, and the ears were well under way before other stalks in the same hill were in bloom. A count showed fifty-eight of the small early stalks and eighty of the tall later sort. The small stalks produced an early crop of ears, a sample of which is shown at 1 in the group of five ears in the lower left-hand corner of Plate III. The greater number of stalks that matured later

produced much larger ears, that, at the same time, exhibited a remarkable variety of forms. Room for only four of these was found in the engraving. The contrast, for example, between the ears at 2 and 5 is indeed striking, but not unexpected, for the former adheres closely to the "Bantam" type, while the other is that of the "Banana," with its long, angular grains, irregularly disposed. An ear like the one at 4 is of unusually fine form and size, and may be considered a blend of the two parental types, and the one at 3 is similar, but much smaller, and possibly less desirable, unless two were generally produced upon the same plant.

"*Golden Bantam-Ruby*" (34/76).—The "Ruby" differs from the ordinary varieties of corn in having the plants purple generally throughout, with the exception of the grains and the leaves; in the latter, however, the midrib is purple, and the expansion from it somewhat of the same color. In the husks and cobs the purple is quite intense, as also in the tassel and silk. It is seen that the plants, as a whole, have an unusual color character aside from the grains. In the latter there are interesting variations, some ears having the kernels of the ordinary white kind, while others show the discoloration of the purple in certain localities, and reminding one of the similar shade of red that is found in the "blood" orange.

As grown for the past three years, the "Ruby" has shown itself to be a tall, stout-stemmed, late sort, with large, well-shaped, usually twelve-rowed ears, and grains broad and fairly deep. A cross with a smaller and earlier variety, as the "Golden Bantam," is seen to be justifiable, and the peculiarities above noted add not a little to the interest one might take in such a combination. From an early stage the crossed plants showed much variability, some of them coming into bloom while others were pushing on to nearly the double height of their neighbors. By the middle of July, it was observed that some stalks were green while others showed the purple color, and, later on, the former produced straw-colored or pinkish tassels and silks while the main portion of the thirty hills showed conspicuous purple tassels and silks. A count was made of the plants and ninety-six were of the purple type, some of them showing this color even in the blade of the leaf, while but eighteen were of the green type. It was found that the size of the plant above considered was not associated with either color type. If the purple is a dominant character of the Mendelian order, theoretically, there should have been twenty-eight green plants, or ten more than actually present. However, the number of instances is too small for any generalization for this crop.

Fifty-nine fine ears were harvested, samples of which are shown in the lower right-hand corner of Plate III. Seventeen were from green stalks and had the ordinary color of husk and cob. Two of these ears are shown at 1 and 2. They are, perhaps, a trifle smaller than the average ears of the whole crop and of remarkably good shape. Three-quarters of the grains are yellow and of a desirable length—that is, the percentage of grains to the mass of the ear is far above the average. Samples of the forty-two ears with purple ("Ruby") husks and cob are shown at 3, 4 and 5, the latter being one of the largest, and showing the blotching of the "blood" in the grains, which makes the white grains more conspicuous here than elsewhere.

It would seem, in the case of the ears, that Mendelism is evident for the numbers for dominant "Ruby" and recessive white are closely approximated. With this in mind, it is hoped to get a cross between the "Ruby" and the "yellow" along at least four lines, namely, (1) "Ruby" plants with yellow grains; (2) "Ruby" plants with white grains; (3) green plants with yellow grains, and (4) green plants with white grains. It remains to be seen whether, when this is done, the vigor of the plant, time of bearing, crop, size of ear, &c., will remain constant in the four strains.

The table qualities of this cross demand a word because the cob (of the "Ruby" type) is of a dark, almost "blood," color, and in this respect is objectionable to some. When the ears are served this seems to be intensified, but the cooking does not discolor the grains, which are quite white, unless they were tinged at the outset.

"Golden Bantam-Livingston's Evergreen" (34/47).—There was only a very limited amount of the seed of this cross, and, to avoid contamination, it was planted late (June 26th), and, from necessity, upon poor soil; the young plants started out well, but they remained small and gave a very inferior crop.

"Golden Bantam" upon *"Mexican-Gentleman"* (34/99/19).—The white grains only of this double cross were planted, and, owing to unavoidably unfavorable conditions, only an inferior yield was secured. No yellow grains were in evidence, and therefore, in this case, the black of the "Mexican" and the yellow of

the "Bantam" had both been eliminated by selecting the recessive white grains for two generations. The zigzag of the "Gentleman" was present to a small extent, and chiefly at the tips of the ears.

"*Golden Bantam-Country Gentleman*" (34/19).—This cross involves a very striking difference in the size of plant and ear arrangement of the grains and time of coming into bearing. The thirty hills were planted, purposely, late, to secure their freedom from mixing with another early block of corn, grown nearby. The conditions were unfavorable for a good crop and only thirty ears of suitable size for seed were harvested, all having three-fourths of their grains yellow. Only seven showed the zigzag type of the "Country Gentleman," while nine were straight-rowed and the remainder had the rows somewhat irregular. In the lower part of Plate II. the male parent is shown at 1 and the mother type at 4, with 2 and 3 as fair samples of the kinds of ears that were obtained by the cross. The shape is good, perhaps better than that of either parent, and is somewhat like a boat, with the butt narrowed in and the upper portion tapering slightly to the end. This is a desirable form of ear and the size is satisfactory if it can be produced early and two ears upon a stalk. Owing to the small size of the block no test of the table ears was made, but the extremely high quality of the "Country Gentleman" parent is much in its favor.

"*Golden Bantam-Stowell's Evergreen*" (34/83).—Thirty hills of this cross were planted late (June 9th) upon land where winter squashes failed, and being somewhat in the shade of large maple trees, did not have a fair chance. At harvest time the three-quarters of yellow grains was apparent. Practically one-fourth of the ears were eight-rowed, like the male parent, and the others had ten, twelve and more rows of kernels. Upon these latter, in particular, the long and much desired type of grain of the "Stowell" was present, and the hope is indulged that, by selection, either a white or a yellow strain (as desired) may be obtained that will be both early and still have a small cob with a large percentage of the edible portion. In the lower part of Plate II. the male and female parents of the cross in question are Nos. 1 and 7, respectively, while the ears at 5 and 6 are selected types of the crosses. The one at 6 may give a larger crop than 5, but more than likely at a loss of speed in coming into table condition.

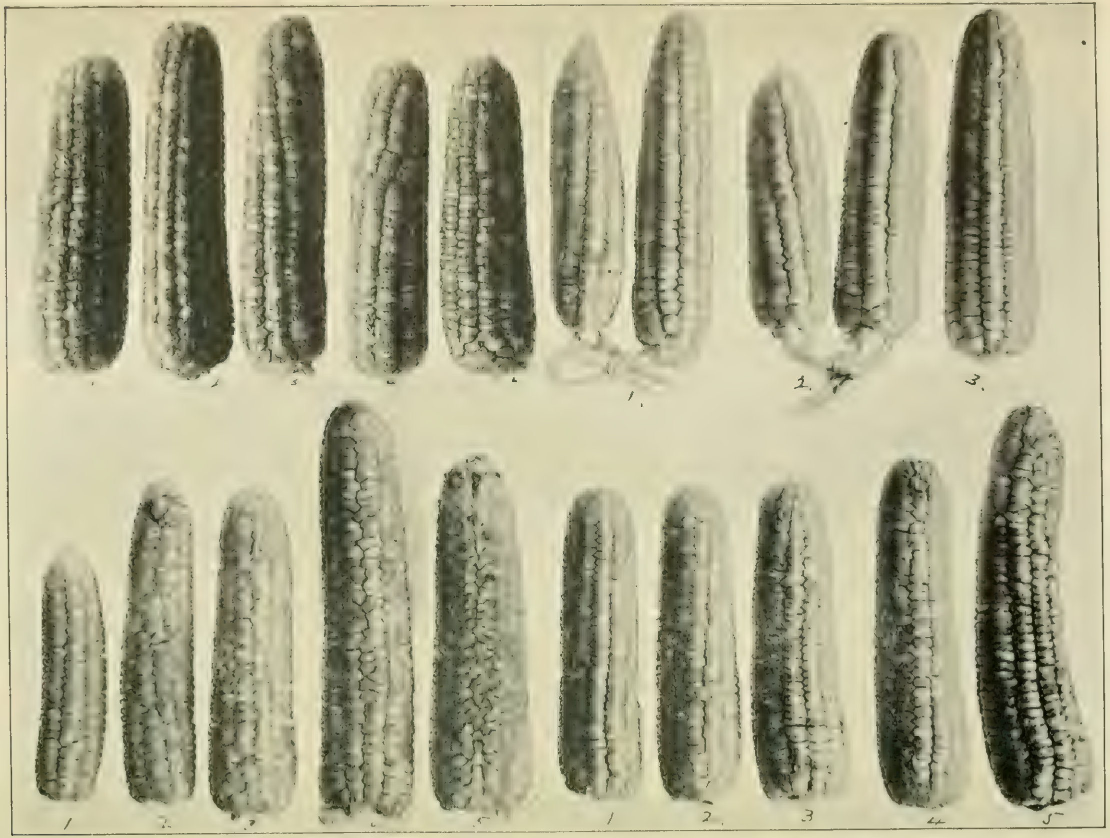

PLATE III.

"*Golden Bantam*" *Cross of Sweet Corn.* "Bantam-Essex Early" is shown in the upper left hand corner (less reduced than the other three sorts). "Bantam-Premier" is in the upper right, showing two pairs of twins at 1 and 2; "Bantam-Banana" is in the left lower, and "Banana-Ruby" in the lower right hand corner.

EXPERIMENTS WITH VARIOUS FLINT CORNS.

During 1905 a list of thirty-one (Nos. 106-136) popcorns made up a breeding block, in connection with which the "Black Mexican" was grown in order to secure crosses with a characteristic dark sweet corn. From the above plot a long list of crosses was obtained, and for the study of these space was given upon the Home Grounds for only five.

"Queen's Golden-White Rice" (114/129).—A set of five ears from a cross of the "Queen's Golden" (114) upon "White Rice" (129) is shown in the upper left-hand corner of Plate IV. This cross produced strong, leafy plants with medium-sized stems that grew eight or more feet high and bore the ears fully five feet above the ground. The tassels were particularly noted as being of unusually large size, and drooped throughout the blooming period. In size of plant, large leaf surface and small stalks for the height, this cross seems to possess value as a forage crop. The ears matured fairly early and were of good size, although the situation was not favorable for a good crop, the plants being near a row of maple trees and, besides, the soil was poor.

Many of the ears harvested were with round-tipped grains instead of being of the "Rice" type, that is, with the free end sharp-pointed, sometimes disagreeably so when the ear is drawn tip foremost through the hand. Ears 1, 3 and 5 in the engraving are with the grains smooth, while the alternating ones are of the genuine "Rice" type, with the one at 4 having the kernels much larger than in the other at 2. This character of the grain tip is one that pertains to the whole ear. Of twenty-seven ears taken at random, seventeen had smooth-tipped grains, seven of the "Rice" type, and three somewhat intermediate. It is possible that several strains of popcorn, varying in color and shape of grain, may be obtained from the cross in question.

"Adams-Black Mexican" (3/99).—The second cross, figured in the upper right-hand corner of Plate IV., is of the "Adams" upon the "Black Mexican." The color of the "Mexican" is clearly dominant, and gives to all the ears a heavy percentage of dark grains, but with some range of variation, as instanced in ears 2 and 3. The shapes of the ears vary greatly, some of them being short and small in diameter, like the "Mexican," as shown at 1, while others

are nearly of the "Adams" type in size, shape and character of large, square-tipped, dented grain, as seen at 5. In number of rows there was very little deviation from twelve, so it would seem in this respect that the "Adams" has greater prepotency than the "Mexican," which is strictly an eight-rowed sort. Nearly all the ears were solid flint, but in a few 10 per cent. or so of the grains were wrinkled. The reason for this lack of uniformity among the ears is not evident.

"Pop-Black Mexican" (x/99).—An exceedingly variable block of corn was obtained by planting the flint grains obtained from a row of "Black Mexican" that was grown among a long list of the various pop varieties. In the lower left-hand corner of the plate is shown five sample ears. The one at 1 is a very neatly-shaped specimen, the grains of which show many shades of dark, light pinks being common. The indications are that the male parent was a "white pearl," which gave a fourteen-rowed ear, partaking strongly of the "pearl" type. One-quarter of the grains are wrinkled, and when separated may give some desirable qualities in a sweet corn. At 2 is shown an ear that has three-fourths of the grains dark and one-quarter yellow. The yellow color is not entirely obliterated by the black, and therefore in this type of crossed ear it may be possible to separate out the pure blacks as well as the pure yellows, leaving the 50 per cent. of the hybrids. In the picture the prevailing yellow color causes the ear (2) to be darker than it naturally appears. The third (3) ear is one of several that were harvested—all of them short, with many rows of square-tipped grains with a prevailing lemon yellow color. This appears to be a result of the crossing of a lemon yellow sort (120) from India, which was a very distinct type in the list of sorts grown last year. In the engraving the light yellow shows nearly white, so that the ear looks less colored than it really is. The wrinkled grains are also clearly seen.

The ear at 4, there appearing black, is a dark wine red throughout excepting the quarter of grains that are evidently pure black. In this instance the red is an ear character instead of belonging to the individual grain, and the red color is apparently only visibly overcome when the grains are of pure black "blood." Here, as elsewhere, one-quarter of the kernels are of the wrinkled sort, and one-fourth of these—that is, one in sixteen of the total—are black.

Further growing of plants from dark ears may lead to considerable further complications.

At 5 is a long, slender, eight-rowed ear, the parentage of which is not far to seek, for it agrees almost exactly in shape with the variety of popcorn known as the "Eight-Rowed," and was one of the sorts represented in the breeding plot the year before. The wrinkled grains are somewhat longer than the others—a fact still more evident in the next set of crosses, and will be mentioned again.

"*Black Pop-Country Gentleman*" (137/19).—The remaining set of ears in the plate represents samples from the cross of "Black Pop" upon "Country Gentleman," and, of course, are of two widely different parents. The notes during the growing season show that the plants were of large size, with stout stems that came into bloom during the middle of July, bearing very large, reddish, drooping tassels and dark purple silks. There were many suckers that reached beyond the slender ears that were borne low upon the stalks. The harvest was upon September 13th, and the record states that there was a fine lot of fairly uniform ears, three-fourths of the grains of which showed the dark color of the popcorn parent. An attempt was made to show, as far as possible, the gradations between the two parents, with the type of ear most nearly like the "Pop" upon the left (1), while the tapering, somewhat curved, form of the mother is given at the right (5). The ears shown at 2, 3 and 4 are representative of the majority of the crop. It is seen from this that the popcorn, which has a slender ear with twelve or more rows of short grains, controlled largely the shape of the ear in the cross. The zigzag disposition of the grains in the "Country Gentleman" is evident in only a small per cent. of the ears, none of them being strictly of the type of the mother. Where the grains were irregularly placed this arrangement was confined to the upper end of the ear, as shown at 3 and 4. The difference between the grains of the two parents is shown in the cross, the black ones, for instance, being shorter than the white wrinkled ones, the latter standing above the flint grains even after the former have undergone the usual shrinking of "sweet" kernels. The same fact of the influence of the parent upon the size of grain in ears resulting from a cross has been observed a number of times elsewhere. By placing a dry ear in a moist place until the grains are fully swollen, the difference in length is emphasized, and the same result may be obtained by letting the shelled grains undergo swelling, as, for example, in advance of germination.

A block of a cross of "Black Pop" upon "Zigzag" sweet corn was grown, but it was too near a row of maple trees to give satisfactory results. The small ears secured, however, showed the usual three-quarters of the dark flint grains, and nearly all had the rows usually fourteen, distinct excepting occasionally at the tip, where the grains were irregularly placed. The exceptional ears were of the true zigzag type, and suggest the thought that the straight-rowed ear is the older or original arrangement of the grains and the zigzag is a recessive type. Some of the ears had the grains with sharp tips, resembling the "Rice" type of popcorn, but those with rounded or smooth tips were in the large majority.

A PRIMARY BREEDING PLOT OF SWEET CORN.

The following twenty-eight (28) numbers occupied the northeast corner of the New Land, that is, the eastern end of Strip III. Each number made a row of fifteen hills across the strip. The breeders were "Cory Red Cob" (16) and "Pride of Nishua" (145), which make Row 5, cutting all other rows at right angles, and a yellow sort from Rhode Island (142) with "Silver Mine" (144), the latter two making Row 10, parallel with Row 5. In other words, hills 5 and 10 of each row across the strip were passed over in the general planting and afterwards filled in with the breeders, as above stated. Each of the two breeder rows contained alternate hills of the two sorts, namely, breeder row 5 had the odd hills of "Cory Red Cob" and the even hills "Pride of Nishua," and breeder row 10 received for odd hills the "Rhode Island Yellow" and for even hills the "Silver Mine."

The point in particular was to study the standard varieties of sweet corns as to characteristics and expose them to the pollen of all of the breeders. The "Cory" differs from all other varieties of sweet corn in the plot in having its grains of a reddish yellow upon a cob of the same color. The "Pride of Nishua" is a standard field corn, the seed ears of which were secured from a corn breeder in Iowa. In this the grains were yellow upon a cinnamon-colored cob. The "Rhode Island Yellow," as its name suggests, is a genuine sweet corn with the yellow grains, and the "Iowa Silver Mine"

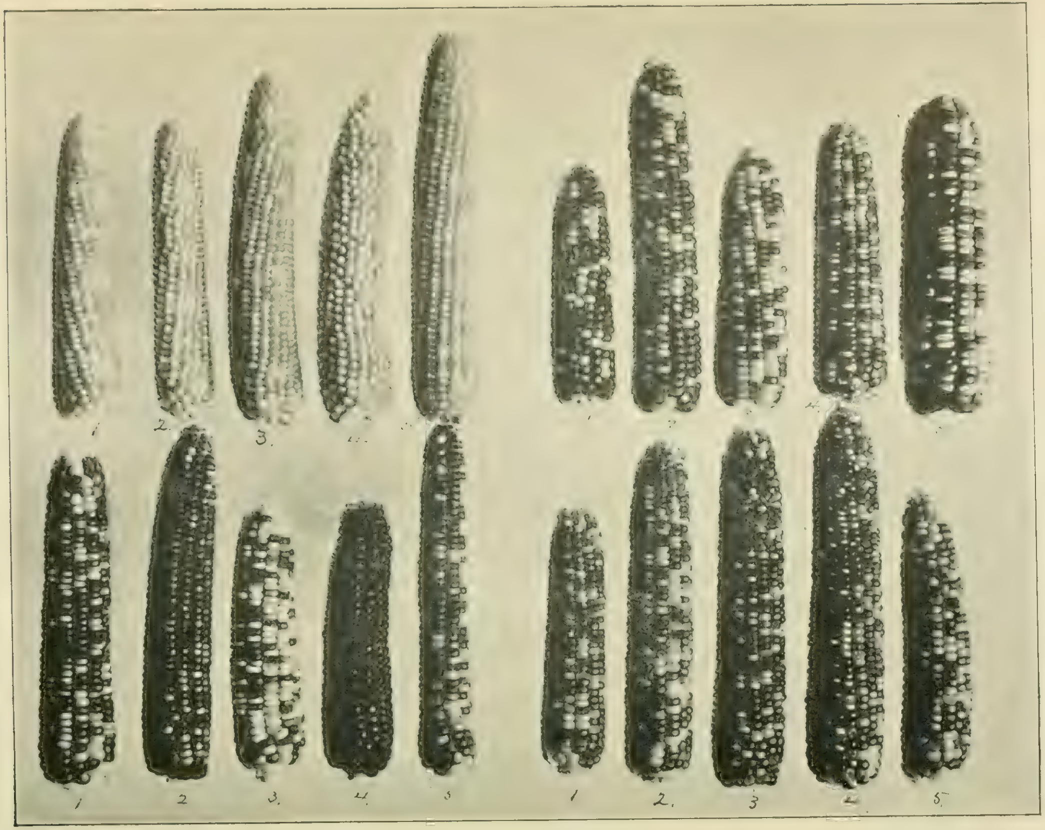

PLATE IV.

Crossed Corns. The "Queen's Golden-White Rice" pop corn is shown in the upper left corner; "Adams-Black Mexican" in the upper right, where ear 1 is like the "Mexican," and the one at 5 is large and with dent grains like the "Adams;" various pop [illegible] and the "Black Pop-Country Gentleman" cross is seen to the right.

is one of the leading white dent varieties grown in the West, and was, with the "Pride of Nishna," obtained from a large breeder of corn in Iowa. The set of twenty-four varieties of sweet corn was selected to be fairly representative of the various kinds, with the exclusion of any having other than a white colored grain and cob.

Row 1. *"Banana"* (6) Farq. It was somewhat unfortunate for this variety that it came at the end of the plot and was damaged thereby, so that only a small crop was secured. Plants came into bloom upon July 20th, showing a brownish tassel and red silk. The harvest was secured upon September 10th, showing that it was medium early. A sample of each kind is shown in Plate V., the "Banana" being at 1.

Row 2. *"Champion,"* early (11), P. H. & Co. A good stand of medium-sized plants was secured, which showed purplish tassels upon July 13th, and the pink silks were past maturity upon the 27th. The fifteen ears, secured on September 6th, were of fair size, were borne low upon the stalk and contained twelve or more rows of fine, long grains, as shown at 2.

Row 3. *"Country Gentleman"* (19) Farq. Upon August 4th, it was noted that the plants were quite uniform in size, with the pinkish tassels and silks appearing. The harvest was secured on September 11th, when it was noted that the stalks were quite tall and the number of fine ears was limited to eight.

Row 4. *"Country Gentleman"* (19) P. H. & Co. This row was planted with seed from another dealer, and proved to be a better row in some respects than the previous one. It was not quite as early in maturing and the harvest (six days later) gave fourteen fine ears. The small ones, perhaps due to inferior situation, in all of these rows have been discarded in the count. A sample ear is shown at 3.

Row 5. *"Crosby,"* early (20), Farq. This quick-growing and small variety was in tassel on July 6th and in full bloom upon the 20th, with tassels straw-colored and silk green. The harvest was upon August 30th and a sample ear is shown at 5, being the best out of the six obtained.

Row 6. *"Crosby,"* early (20), P. H. & Co. This row was practically the same as the previous one in earliness, smallness of plants and meagerness of yield, there being only five good-sized ears.

Row 7. *"Henderson"* (39) P. H. & Co. This gave a fine row of tall, stout plants, producing many suckers, and came into full bloom, with tassels purple and silks varying from green to pink, upon July 27th. The mature ears were gathered upon September 10th, yielding thirty ears, a fair sample of which is shown at 7. This was one of the best rows in the whole plot. So far as yield is concerned, no test was made in any case of the quality of the table corn.

Row 8. *"Hurd's Hiawatha"* (41) P. H. & Co. This was a good row, considering the circumstances, with the plants of good height, the upper leaves particularly broad and fine, and was in bloom, with pink silks and straw-colored tassels, upon July 27th. The harvest was made on the 11th of September, when twelve ears were secured, an average sample being shown at 8.

Row 9. *"Hickox Improved"* (42) P. H. & Co. This was an even row of five plants, marked "tall" in the record book, and had an unusually long blooming period, beginning upon July 20th. The mature ears were secured upon September 14th, one of the twelve of good size being shown at 9.

Row 10. *"Mammoth,"* (early) (49), P. H. & Co. This gave a row of tall, leafy plants, the tassels of which began to appear upon July 27th, and were in full bloom on August 4th. The mature crop was harvested upon the 11th of September, when fifteen large ears were taken, a sample being shown at 10.

Row 11. *"Mammoth,"* (late) (50), P. H. & Co. This proved to be practically the same as the above row, although not as good. The crop was harvested upon the same day as the last and only eight large ears were secured, one of which is shown at 11.

Row 12. *"Metropolitan"* (57) C. H. Lilly Co. This uneven row of plants, in some measure due to the character of the soil, came into bloom, with purple tassels and pink or green silks, upon July 27th. The harvest was secured upon September 11th, there being nine good ears, one of which is shown at 12.

Row 13. *"Metropolitan"* (57) P. H. & Co. This row differed somewhat from the last named and the harvest consisted of ten sizeable ears, one of which is shown at 13.

Row 14. *"Minnesota Early"* (58) P. H. & Co. The note-book records for this: "A good row; in tassel July 13th, with purple tassels and pink silks; the harvest was upon September 2d," showing its earliness, when eight ears were secured, one of which is pictured at 14.

Row 15. *"Moore's Early Concord"* (61) P. H. & Co. This was a good row of medium-sized plants and began to bloom upon July 20th, having purple tassels and silks, the latter varying to green. The harvest was upon September 5th, when ten ears of the size shown at 15 were secured. This was one of the best rows of the earlier varieties.

Row 16. *"Ne Plus Ultra"* (62) P. H. & Co. Several of the hills were without plants in this row and no replanting was made, so that the plants were comparatively few. They were medium in time of bloom, namely, July 27th, the plants being rather short and stout. Only six good ears were secured September 6th, one of which is shown at 16.

Row 17. *"Old Colony"* (64) P. H. & Co. Unfortunately, this row, and two or three others, were in the area infested with quack grass, which undoubtedly interfered with its development. The plants were variable, coming into bloom, with purple tassels and pink silks, upon July 27th, and were ready for harvest on September 11th, when ten ears of the type shown at 17 were secured.

Row 18. "*Squantum*" (69) P. H. & Co. This was only a fair row of uneven plants, beginning to bloom upon July 20th, with purple tassels and pink silks. The crop, however, was above the average, there being sixteen ears gathered upon the 14th of September, and these were of a satisfactory shape, as shown in 18.

Row 19. "*Premo*" (71) C. H. Lilly Co. This was a poor row of plants, which were in full bloom upon July 20th, with purple tassels and silks, varying from pink to green. Five ears were harvested on September 11th, one of which is shown at 19.

Row 20. "*Shaker's Early*" (78) P. H. & Co. The plants in this row were of good size and bloomed upon July 20th, showing straw-colored tassels and green silks. The harvest was upon the 12th of September, when only six ears of fair size, as shown at 20, were secured.

Row 21. "*Stabler's Early*" (81) P. H. & Co. This row of medium-sized plants began to tassel upon the 13th of July and had a long period of blooming. At harvest time, September 10th, ten ears of a long, slender type, as shown at 21, were secured.

Row 22. "*Stowell's Evergreen*" (83) Farq. This was a fair row of broad-leaved plants, which were in full bloom upon August 4th. The harvest was upon the 17th of September, when seven good-sized ears, as shown at 22, were obtained.

Row 23. "*Stowell's Evergreen*" (83) P. H. & Co. This row was not as good as the one preceding; somewhat earlier and smaller, but yielded the same number of ears upon the same date of harvesting.

Row 24. "*Guerin*" (143) Guerin. This end row was made up of medium-sized, slender plants, which came into full bloom on the 20th of July, bearing purple tassels and pale-green silks, and, upon the 11th of September, gave a harvest of eleven long, slender, eight-rowed ears, as shown at 24.

The seed used in all of the above twenty-four rows was taken from sample ears, secured from the dealers whose initials are appended to the name of the variety. These ears are preserved in the Museum of the Department for the sake of ready reference to the type of grain, ear, &c., that was used in each case.

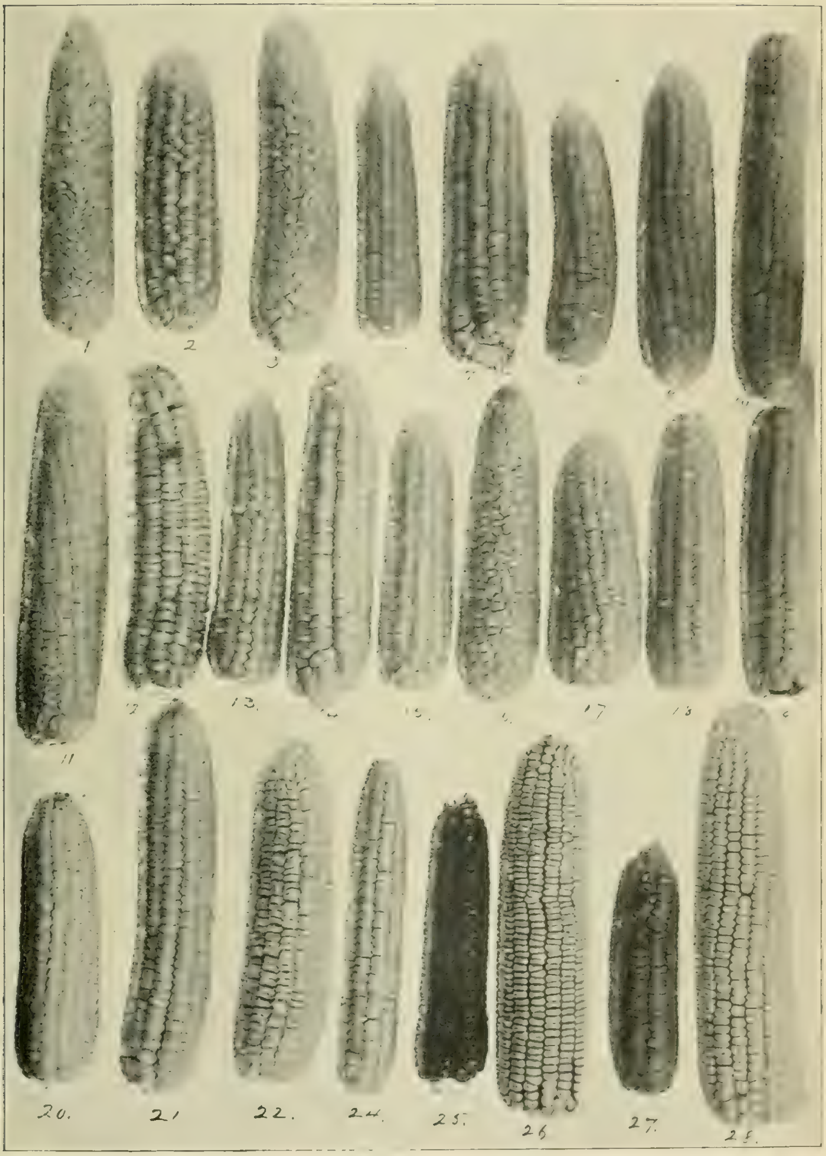
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PLATE V.

Sample ears of various commercial varieties grown upon poor soil during 1906.

The Four Breeders.

The "Cory Red Cob" (16) is a small, early variety, and upon the poor soil it hastened to maturity. An ear is shown at 25, where the red color of the grains appears nearly black. It was noted that the color of the grain of this variety, as expected, was not marked upon any of the surrounding kinds, and the fact of a cross can only be determined in the future crop.

The "Pride of Nishua" (145), as before stated, is a large and choice field variety of dent corn secured from Iowa. It grew to the height of nine to eleven feet and bloomed later than the surrounding sweet varieties, but some grains of it, crossed upon the sweet neighbors, were obtained for a majority of the varieties. The size and general appearance of this corn may be determined from the ear shown at 26. Whether the crosses thus secured will have the great vigor of the "Nishua," combined with the full sweetness of the table sorts, is problematical.

The "Rhode Island Yellow" (142) proved too small and early to permit of many crosses being secured. One of the largest ears is shown at 27, which is in striking contrast with the larger field sorts upon either side.

The "Iowa Silver Mine" (144) was a very strong grower and made stalks that overtopped the sweet corns among which it grew. The longer growing period and lateness of blooming interfered with the crossing, so that only an occasional grain of white dent was found in the ears of the sweet sorts. As the ear at 28 shows, this white dent variety is larger than the "Nishua," and far outmeasures the ears of the various sweet kinds.

"BLACK MEXICAN" AND OTHER CROSSES–CO-OPERATIVE TESTS.

In response to requests for samples of crossed corn, thirty-six packets were distributed last spring. From the reports rendered up to the date of writing (November 10th), the following notes are condensed. (The color of seed grains planted in each case follows the name of the cross.)

"Mexican-Banana" (99/6). White grains. Hon. James Neilson reports upon his test for this cross as follows: "A very good,

medium-early corn; planted at same time as 'Stowell's Evergreen,' was ready five days earlier; height, six feet; flavor good and very tender." The dozen and more of sample ears brought to the Experiment Station were all pure white and showed but little of the zigzag tendency.

"*Mexican-Banana*" (99/6). Black grains. Mr. George M. Hoffman reports upon his test of this cross: "Ears are small; did not have very good success with this cross." From the few ears sent in, it is evident that the usual amount of white "blood" was concealed in the dark seed, and that the straight rows of the "Mexican" prevailed over the zigzag of the "Banana."

"*Mexican-Gold Coin Evergreen*" (99/26). Black grains. Mr. W. T. Woerner writes of his test with this cross: "Planted May 17th, ripe September 15th; quite prolific; one and two ears to the stalk."

"*Mexican-First in Market*" (99/31). Dark grains. Rev. William F. Bond reports that: "The success with this corn was all that we could expect; it was a very special favorite on our table; we were well pleased with the experiment and the results."

"*Mexican-First in Market*" (99/31). White grains. Mr. M. S. Crane writes: "Some of the ears kept show a spattering of dark blue kernels, also a few white and yellow ones." The three ears sent in are all of good size, twelve to fourteen rowed, and with all the grains white. There was likely a kernel planted bearing black "blood."

"*Mexican-Hiawatha*" (99/41). White grains. Mr. Frank Bingham reports upon his test of this cross as follows: "Vigorous but black corn does not sell well here." The four ears sent in are solid white, with one exception. The chief fault with them is a tendency toward flintiness, seen particularly in one ear.

"*Mexican-Kendel's Giant*" (99/44). White grains. P. B. Randolph & Son report: "Planted April 30th, in fairly good soil; reached condition for table by August 1st; ears twelve-rowed, seven to nine inches in length; quality excellent, very sweet; the stalks grew two different heights—five and seven feet." From the ears submitted it is seen that there was a little black "blood" present. The matter of two sizes of stalks will require further investigation.

"*Mexican-Maule's XX.*" (99/55). Black grains. Mr. J. E. Kuhns reports as follows: "Planted May 15th; first edible ears by August 1st; strong grower; two good ears on most stalks; quality excellent at its best stage." The ears sent to the Experiment Station were fine and showed the usual percentage of white grains. Some of the kernels showed some excess of starch, but probably not due to mixture in the field.

"*Mexican-Roslyn Hybrid*" (99/75). Black grains. Mr. F. B. Kilmer reports upon this cross as follows: "This corn grew well; about five and one-half feet high, about two ears to each stalk and was of excellent quality for eating—in fact, those who used it state that it was the best sweet corn which had ever been produced." The package of ears brought in showed that the cross was far from fixed, and that there was much hope, by selection, of securing a desirable sort.

Mr. A. R. Lewis grew the same cross and color of seed grains, and "used twelve ears for the table and the corn gave entire satisfaction." Six ears were sent to the Experiment Station, and of these three were solid black and the other three showed a small percentage of white, and, in addition, one of the last-named had an admixture of yellow dent that, it is inferred, came from some field corn growing in the neighborhood. This last ear is particularly interesting, because it shows the blending of the dark and yellow color in all the dark flint grains. In other words, these grains carry the starch and the sugar characteristics—the latter hidden or recessive, and two colors, both in sight—and furnish a stock for breeding and selection.

"*Mexican-Garwood*" (99/94). Black grains. Mr. Henry R. Jones reports upon his test of this cross as follows: "Yield was very good and it was fit to eat about the same time as other corn that was planted two weeks earlier; very much pleased with the corn; a very delicious table corn."

The same cross from white grains was grown upon the Home Grounds and showed much of promise. It is mentioned elsewhere.

"*Golden Bantam-Marblehead*" (34/51). This cross was grown by Mr. W. B. Cook, who sent a very attractive ear—almost ideal, barring, perhaps, a taper that some growers and experts object to. All the crop was accidentally destroyed excepting this single ear, and therefore another generation will need to be grown before seed can be offered for testing. Mr. Cook writes: "We tested it on the table and it was very good." This is a promising cross.

"*Golden Bantam*" upon "*Gentleman-Mexican*" (34//19/99). This double cross was grown by W. T. Woerner, who reported that it was "quite prolific, good-sized ears, good table quality, although the test was not under the very best conditions." Four ears were sent to the Experiment Station, all of satisfactory size and shape—two eight and two twelve-rowed. There were some variations in the deepness of the yellow, one eight-rowed ear being a dark yellow while a twelve-rowed one was pale amber. Much selection will be needed to fix the color and remove the eight-rowed ears, if it is desired.

"*Earliest Table-Early Sunrise*" (87/86). A cross was secured in 1904 of "Earliest Table" (87) upon "Early Sunrise" (86), and the flint grains were planted last year, yielding ears that had three-quarters of the grains flint and one-quarter wrinkled. The latter sweet grains were grown in isolation the present season by Mr. J. P. Nelson, who, in sending eighteen mature ears, submits the following notes: "Stalks short, ears small, one and two to the stalk; ripens early; quality good, but only for a short time, and must be used at the right time or it will get too old."

As both parents were of the small type of early plants, with white grains and eight-rowed ears, the chief point of difference was the character of the kernel. A comparison of the ears of this generation of the cross with ears saved at the time the cross was made, confirms the first impression that some of the former are a blend of the sweet and flint. Of the eighteen ears, five show combinations of the two characters, namely, flint and sweet, and of these three have it more pronounced than the others.

An ordinary sweet grain is uniformly wrinkled and has none of the white interior showing through the smooth, plump coats, as in the flint kernels. In the present instance, the grains are wrinkled upon the free exterior as the kernel sits in position upon the cob, through which a white interior is visible, either as a small dot or a longitudinal line. A fully sweet grain, when cut lengthwise the narrow way of the kernel, shows no white or starchy portion, while those in question show an area above the embryo—that is, upon the upper side of the grain—that is quite white with the starch. Other grains of this same blend show the starch more abundantly, and so fill up the interior as to prohibit any more than a slight shrinking at maturity. Grains were not infrequently found with the wrinkles upon one or other of the two halves.

Some of the commercial varieties of sweet corn show this type of grain, as, for example, the "Kendel's Early Giant" (44), of which it was stated, in the report for 1904, "it is easily distinguished * * * by the peculiar appearance of the grains, which are long and thick, and not as much shriveled as are the two sweet corns. * * * These facts suggest that it may be a cross between the true sweet and a flint corn."

By growing a crop from these blend grains, further information may be obtained as to the permanence of the combination of qualities above noted.

"*Rhode Island Yellow-Ne Plus Ultra*" (142/62). Mr. J. B. Johnson reports of this cross: "Made a rank growth from start; set from three to five ears to a stalk." The three ears submitted from the test are all satisfactory, and, by selection, an early yellow zigzag may be expected.

"*Hess*" (97). Red grains. Mr. J. W. Armstrong reports as follows: "Planted May 6th; roasting ears August 6th; a little later than the white of 'Hess,' but was on lower ground; quality good; all shades of red, from dark to white; stalks and leaves all shades, from dark purple to green; in cutting, I noticed two or three purple all through, even the pith."

"*Hess*" (97). White grains. Mr. J. W. Armstrong also grew the white grains of this cross, and reports: "The white grains were planted May 6th and gave ears August 1st; this is an excellent corn, sweet and tender."

The "Hess" is a strain of sweet corn with two colors of ears, the "red" and the "white," and seed of both colors were grown in isolation by the same breeder. In previous years, at the Garden and elsewhere, the two colors have been grown side by side with other varieties, but in no instance has the red been found to make any immediate mark upon the neighboring white ears, and no white grains appear in the red ears.

Mr. Armstrong grew a crop from red seed in 1905, and from his report the following is taken: "Gathered twenty-four ears, but some red ears were darker than others; there were no white grains on the red ears and no red grains on the white ears."

In his plot planted with white grains, he did not find any red ears, but in the plot planted with the red grains there was three per cent. or so (an exact record not being made) of white ears. It is seen from this that the white grains, in isolation, may breed true and be recessive, while the red ones produce a small number of white ears, showing that the red color behaves like a dominant character.

Cross of "Eight-Rowed" and "Black" Pop Corn (121/137).

The seeds of the two parents, "Eight-Rowed" and "Black Pop," were grown in alternate rows, in isolation, by Mr. William H. Reid, who sent to the Experiment Station last year a quantity of the "Eight-Rowed" sort, very thoroughly mixed with the "Black," but the grains showing the combination were pinkish, and not of the black of the male parent. The amount of the discoloration of the white grains varied greatly, in some kernels it being only slight, and seen with difficulty, while others were a dull, dark red.

The grains showing the cross were planted this year by Mr. Reid, and the twenty-four ears at hand are quite uniform in having three-quarters of the grains discolored and the remaining quarter white. It is noted that some ears have the discolored grains of two general groups, namely, those that are solid black and others with less darkness, making it possible to hope the pure black may be separated at once, as well as the pure whites, leaving the hybrids by themselves. A student kindly selected and counted the grains upon four average ears, with the result that 463 were black, 554 white and 827 mixed, thus giving the following percentages: Black, 25.1; white, 30.0, and mixed, 44.9. It is seen that the white exceeds the theoretical amount, but the fact that the quarter of presumably pure black grains can be separated seems to be demonstrated in this case. It remains to show by process of cropping that the black grains, thus separated, are true to their color. Some ears have a blackish red for the pure dark grains, the presumed hybrids varying to a lighter shade, accordingly.

It is further noted that eighteen of the twenty-four ears are ten or more rowed, like the "Black" parent, and six are eight-rowed, like the white parent. In other respects, difficult to define, the ears are of two types, strongly suggesting the parent that has a controlling influence in the cross. Should all crosses between a distinctly eight-rowed sort and one with a larger number of rows result as the small set in this cross, it would point toward the number of rows being a Mendelian character.

The cross gives a marked increase in size over either parent, a fact not unusual in the crop the first year after combination.

"Voorhees Red" Sweet Corn.

Another season has been added to the period of testing of the "Voorhees Red" sweet corn, and the reports are very favorable, as a few of the remarks given below, from some of those who have grown it for years, will testify: "The average height of the crop of 'Voorhees Red' was eighty-eight inches; the yield of the whole crop, per acre, was fifteen tons; the uniformity was good and the color between a red and a purple." "Average height of stalks, six feet; average number of ears to a stalk was three, sometimes five; sets well filled, quality very good; with more time and more selection, seems to promise to be one of the best." "The 'Voorhees Red' is a fine corn and I shall continue to grow it." "'Voorhees Red' turned out well this year." "Corn was sweet and nice; stalks were from five to six feet high, with two ears to a stalk." "Ears good size, filled out to the end, one to two ears to a stalk; grains good size, light red to dark red in color, when fully ripe, showing only a faint trace of red when fit for the table; quality sweet and good; will grow it again next season." "Seed germinated promptly; good stand; stalks six to seven feet high; first planting matured in August; was away when corn was ripe, but neighbors who used it say it was the sweetest corn they ever ate; second planting matured in September; furnished seed to two neighbors, who are pleased with the corn; I regard it as excellent and have saved seed for next year." "'Voorhees Red' did very well with us; the grains were very nearly all of a size; we like the corn very much; ears very sweet and tender, and two ears on most stalks." "I like this corn in every way." "Ears fill out better than ordinary sweet corn and will yield better." "Corn has made a most excellent showing and is all that could be desired; very sweet and productive." "Corn is much in favor; ears of good flavor and tenderness." "'Voorhees Red' corn came up well and grew nicely; stalks of good height; eared well, averaging about six inches in length, of good size for table corn; we ate some of it for a test and found it very sweet and tender; am so well pleased with it that I saved about twenty ears for seed, part of which I intend giving to some of my friends to try next year, as I feel that I can recommend it for table use as a very satisfactory addition to the many varieties of sweet corn." "Quality good and sweet." "The 'Voorhees Red' sweet corn did well this season; the stalks were from five and a half to six feet, bearing from two to three ears to a stalk; ears full, of medium size and deliciously sweet." "The quality is not changed, unless it is more tender; it is the very best sweet corn in existence and you should be proud of producing such a variety." "The choicest corn I ever ate." "Sweet and delicious in flavor." "The 'Voorhees Red' sweet corn was valued highly."

GENERAL NOTES UPON CORN.

When the straight-rowed varieties are bred with those of the zigzag type, as has been done in many instances, the blend plants produce ears that show a strong preponderance of the straight rows. In some cases there may be only an occasional ear that is entirely zigzag, but as a rule there are many with the upper third of the ear with the grains irregularly disposed. Whether the relation between the two types of grain-arrangement can be expressed in any fractional form or ratio remains to be seen. It would seem that the straight-rowed type is the primary one and the zigzag is a later development, that in crosses between the two, in some cases, persists in the ear tips. The possibility of obtaining by selection a variety with the double type constantly present is not, perhaps, without hope, even if it is without manifest profit. The origin of the ear is a natural subject for inquiry in the face of these commingling types.

Mr. Montgomery, of the University of Nebraska,* has recently presented an opinion that the modern corn ear has developed from the central spike of a tassel. This view presumes that "the progenitor of the corn was a large, much-branched grass, each branch being terminated by a tassel-like structure, bearing hermaphrodite flowers. * * * As evolution progressed the central tassel came to produce only staminate flowers * * * and the lateral branches came to produce only pistillate flowers." Several engravings are given of "sucker" ears, in which stages in the development of the central spike of the tassel into an ear of corn are given, stages that in a general way are familiar to all who have knowledge of corn in the field. As the male flowers are borne in pairs and in from four to eleven rows, by replacement, the grains consequently are in double rows, which is clear so far as the straight-rowed ears are concerned. In the zigzag ears, when the kernels are removed, the cob shows that by a slight displacement the young grains are developed out of line, and, by pressure, the mature kernels may take on the irregular ("shoepeg") form. If this view be the true one, the zigzag type is in a degree accidental and might be expected, as it is found occasionally in many kinds of corn, but that, by selection, it can be fixed as a varietal characteristic is not in violation of a general rule.

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* "What is an Ear of Corn?"—Popular Science Monthly, January, 1906.

The study of corn blends is not without its points of interest. There is a wide difference in varieties as to the influence had upon the cross. In some instances the plants are not widely different, to begin with, and the results are accordingly meager. It goes without saying, in other words, that in order to have an interesting cross, there needs to be two or more characteristics that are not in common. The crossing, for example, of the "Black Mexican" and the "Egyptian," which, while differing in minor points (as shape of ears, rows upon the cob, &c.), were very unlike in the color of the grain, and the result is a kernel of a dark red color, which is entirely unlike either parent. It seems to be a creation in the cross, and, in time, it is hoped to demonstrate what effect the "Voorhees" will exert upon white and other sorts of sweet and field corns. It is possible that, in breeding, its crosses may not show the same red color, but, instead, possibly the black of the "Mexican."

The breeding of the "Golden Bantam" upon the "Banana" has been interesting in that it furnished a block of very variable plants, in height, time of maturity, form and size of ears and the disposition of the grains upon the cob. A large number of the small, early plants can best be understood by accepting the view that they were from grains of pure "Golden Bantam," that for some reason, not yet explained, were mixed with the crossed kernels. With those eliminated, there still remains a great diversity of plants. The few late ones, green after all others were mature, had large, zigzag ears, in striking contrast with the mass of straight-rowed ears, but all alike in the three-quarters of yellow grains.

This cross, in its blend generation, where similarity is looked for, is a good illustration of the greater size of the product than obtains with either parent. The "Golden-Bantam" is, as said, a small variety in every way, and the "Banana" produces ears, as a rule, smaller than the "Country Gentleman," but in the crop obtained in the blend they were more nearly the size of the "Stowell's Evergreen" and varieties of that type.

There is a tendency to produce suckers in the blend plants, exceeding that in the parents and far beyond that of the plants that follow in after years. In short, the vigor seems to be much enhanced by the operation of the cross, and it may be true, and evidence points that way, that the wider the cross among varieties the greater the increase in vital activities.

The crosses of sweet and pop corns were wide, indeed, and here the blend plants, even upon very poor soil, grew vigorously, and, where possible, produced ears that outmeasured the average of the parents. Thus the "Black Pop" upon "Country Gentleman" produced ears exceeding in length the average of the two varieties involved, and under the same circumstances their progeny may fall far short of the same dimensions.

EXPERIMENTS WITH TOMATOES.

Old Varieties Grown the Present Season.

The number of commercial varieties of tomatoes grown the present season is much reduced from that of the two previous years. The list includes only the parents of the crosses that were selected for testing in the Gardens, to which was added the novelties that appeared for the season of 1906. The following is the list of the parents, entered here without comment, as the notes upon them have been given in previous reports:

1. "Acme."
4. "Arcadia."
6. "Atlantic Prize."
8. "Beauty."
14. "Bright and Early."
15. "Brinton's Best."
21. "Climbing."
26. "Crimson Cushion."
28. "Cumberland."
29. "Dominion Day."
32. "Duke of York."
33. "Earliana."
42. "Early Ruby."
44. "Enormous."
49. "Favorite."
53. "Fortune."
54. "Freedom."
55. "Frogmore."
56. "Giant."
57. "Giant Climbing."
60. "Honor Bright."
63. "Imperial."
64. "King Humbert."
66. "Jewel."
75. "Magnus."
77. "Marvel."
85. "Michigan."
87. "Minnesota."
90. "Mikado."
98. "Paragon."
103. "Ponderosa."
110. "Quicksure."
119. "South Jersey."
121. "Stone."
143. "1903."
145. "Golden Queen."
147. "Lemon Blush."
148. "Yellow Prince."
149. "Aristocrat."
153. "Champion."
156. "Champion Scarlet."
158. "Dandy Dwarf."
159. "Extra Early Tree."
169. "Dwarf Stone."
172. "Gold Ball."
175. "Ivory Ball."
177. "Red Currant."
179. "Red Pear."

Novelties or Varieties Not Before Grown in the Gardens.

No. 213. "Laycock." This was obtained from the originator (whose name it bears) in England, as it was reported to have exceptionally desirable qualities. The plants were of the normal type, with somewhat longer stems than the average standard fine-leaved sorts. The fruit, of the ordinary "red" color, was medium late in maturing and was not abundant. In form the tomatoes were somewhat longer than the average upon one plant, suggesting that it contained the "King Humbert" "blood," and, along with it, a flabbiness that is not desired. In breeding with varieties with solidity of flesh and minimum seediness, it may prove of value in lengthening the axis of the fruit.

No. 214. "Earliana" (Strain No. 10). This was offered as an improvement upon the "Earliana," now a recognized leader in the State as an early productive variety. It was somewhat superior to the regular type in showing less of the concentric cracks upon the shoulder of the fruit, but there was some loss in yield and a tendency to a long-bearing season.

No. 215. "Earliest Pink." This variety was true to name in yielding a pink fruit, but it did not produce them very early or in great abundance.

No. 216. "Hubert's Marvel." In this variety there was suggestion of lack of fixity of type. The plants were only of fair size and the fruit was usually under the desired size.

No. 217. "June Pink." This sort has earliness as its leading quality. The record for July 7th shows the first ripe fruit. Upon the 11th of September the record is that the variety is not very desirable.

No. 218. "Jerrard's New." The plants were of medium size and matured their fruits among the first of all. Other than earliness, the variety has no great merit.

No. 219. "Greater Baltimore." For some unknown reason, the plants of this novelty were lacking in vigor and did not do well. An improvement was noted later in the season, when a fair crop of good-sized fruits was produced.

The "Puget Sound Special" (211), grown last year from seed obtained from the Northwest, was given a second trial from home-grown seed, but, as before, the plants (of dwarf type) were not desirable.

Notes Upon Some of the Leading Crosses.

The "Magnerosa."

The "Magnerosa" was grown in considerable quantity during the season of 1906 and in the following combinations of the parent sorts: 75/103, 75//75/103, 75/103//75 and 75/103//103.

The fractions indicate that 75, which is the record number for "Magnus"—a standard, coarse-leaved, pink-fruited variety—was crossed upon 103, the number for "Ponderosa," a standard, fine-leaved, pink-fruited sort. The original cross, made in 1903, has been grown each year from selected plants, both in the field and greenhouse, thus getting two crops a year, until a fair degree of uniformity is obtained. The second fraction indicates that the "Magnus" has been bred to the cross just mentioned, so that the off-spring of 75//75/103 may be said to be three-quarters "Magnus" (75) to one-quarter of "Ponderosa" (103). The reciprocal to the last is where the cross is bred upon "Magnus," as indicated in the compound fraction, 75/103//75, the double line being the division lines of the second combination. The second fraction, given at the outset, is readily interpreted as a cross of the "Magnerosa" proper upon the "Ponderosa," as indicated by the double lines. The last-named cross shows too great a preponderance of the "Ponderosa," in that the fruits are too large, flat and rough—that is, ribbed and corrugated—and do not ripen evenly. In short, this combination is only a slight improvement over the "Ponderosa," and, while this row was very prolific, no seed from it was saved.

From a study of the two reciprocals with the "Magnus" three-quarters, it is seen that the fruits are remarkably fine, being smooth, quite apple-shaped, and, of course, always pink. From these rows seed from selected plants has been saved, and from one plant in particular that, with its superior fruitfulness, showed a much-desired length of axis in the fruit.

There are two possible types of foliage in the "Magnerosa," namely, the fine-leaved, or ordinary kind represented in the "Ponderosa," and the coarse-leaved, or "potato" type of foliage of the "Magnus." The fine-leaved type has been decided upon for "Magnerosa," but, as it is not possible to eliminate the coarse-leaved type except by individual separation, there will be "potato" plants showing themselves in diminishing numbers from year to year. These, however, can all be thrown out as seedlings and the field kept to one type of leaf.

Reports from Testers of "Magnerosa" Tomato.

Seed of the "Magnerosa" was distributed, by request, to one hundred and ninety-two persons in the State, and from a large number of these reports have been received by the Experiment Station. The following are some of the comments taken from the replies, the quotation marks separating the remarks in the individual reports: "The 'Magnerosa' tomatoes have developed a very rank growth of strong vines which are heavily fruited." "The tomato is very large, very smooth, ripens fast, uniform in size, hearty and strong, fine flavor and color of beefsteak when cut apart.” “The ‘Magnerosa’ is a good growing vine and well laden with fruit, smooth, large and good quality.” “‘Magnerosa’ doing well and has set considerable fruit.” “‘Magnerosa’ has proved to be a very good kind of tomato, large, smooth and productive.” “Vigorous, sturdy plants.” “Shows no blight, very vigorous and productive with a mass of fine fruit.” “Plants vigorous growers from start, large leaves, some entire, all foliage dark green; plants well filled with fruit, flavor good, promises to be very valuable, looks to be a good yielder, so far a very desirable tomato.” “Plant very hearty, largest fruit nine inches around.” “‘Magnerosa’ tomato is fine, large size, vigorous grower, fine color and flavor.” “Twenty to twenty-five tomatoes on each plant, fruit fine-shaped and of a beautiful crimson color, measuring from ten to twelve inches in circumference; certainly very fine; vines are still green and vigorous with blossoms on top at this date; we have more tomatoes than all our neighbors put together.” “I am much pleased with this tomato; present outlook very good.” “Are of good size and good shape.” “A very good shipper.” “Tomatoes are now ripe and they are certainly fine; we have also had three other kinds, but these are the best; the uniformity of the fruit seems to be perfect.” “Am pleased with it; yield with me is about the same as ‘Livingston’s Stone,’ but think the quality better.” “Am well pleased with it; the size is good, and, in my opinion, this tomato has many good qualities.” “Promises to be an excellent fruit.” “Many fruits large, all fair size.” “Tomatoes set out and were ripe in sixty-two days; plants very thrifty.” “Am much pleased with the ‘Magnerosa’ tomato; plant is very vigorous and productive, fruit is large and very uniform; I picked one tomato that measured sixteen inches in circumference.” “My customers prefer it to other kinds; is a fine bearer.” “I find the ‘Magnerosa’ far above the average, a very strong grower, good producer, fruit is large, no small ones; the meaty part is very solid and of a very fine flavor; I have a garden of two acres with a large lot of tomatoes and these are in the lead.” “Quality is very fine.” “The fruit is handsome and am well pleased with it; very showy and solid.” “The plants are doing splendidly and are looking as well as any of the other varieties that are growing near them; the productiveness and shape are in every way satisfactory.” “A great improvement on the ‘Ponderosa.’ ” “A valuable fruit for late." "Strong growers and well filled." "'Magnerosa' is doing finely; have picked about five baskets from eighteen plants already and more to come; size large as a Bartlett pear, shape more like a round ball; color red as fire and it keeps well as far as I can see." "The largest fruit weighs half a pound." "They keep well after being picked from vines." "I am much pleased to get so fine a tomato." "Vigor and productiveness of plants excellent." "Quality of fruit is of the best; we never had better tomatoes." "The 'Magnerosa' I am much pleased with." "Very strong growing plants, well loaded with good-sized fruit." "My plants are looking fine with fruit of good size, plants stocky, fruit well formed and has plenty of it; promises to be an excellent fruit." "The plants grew vigorously and on trellis reached over five feet in height, producing bunches of fruit, or clusters of from four to nine in a cluster and very plentifully." "Holds its good size to the end of season." "Tomatoes smooth and perfectly shaped and of fair size." "The tomatoes are fine, a good grower and good bearer, flavor fine, fruit firm and of medium size."

The "Marvelosa"—("Marvel-Ponderosa"—77/103)—Station No. 5.

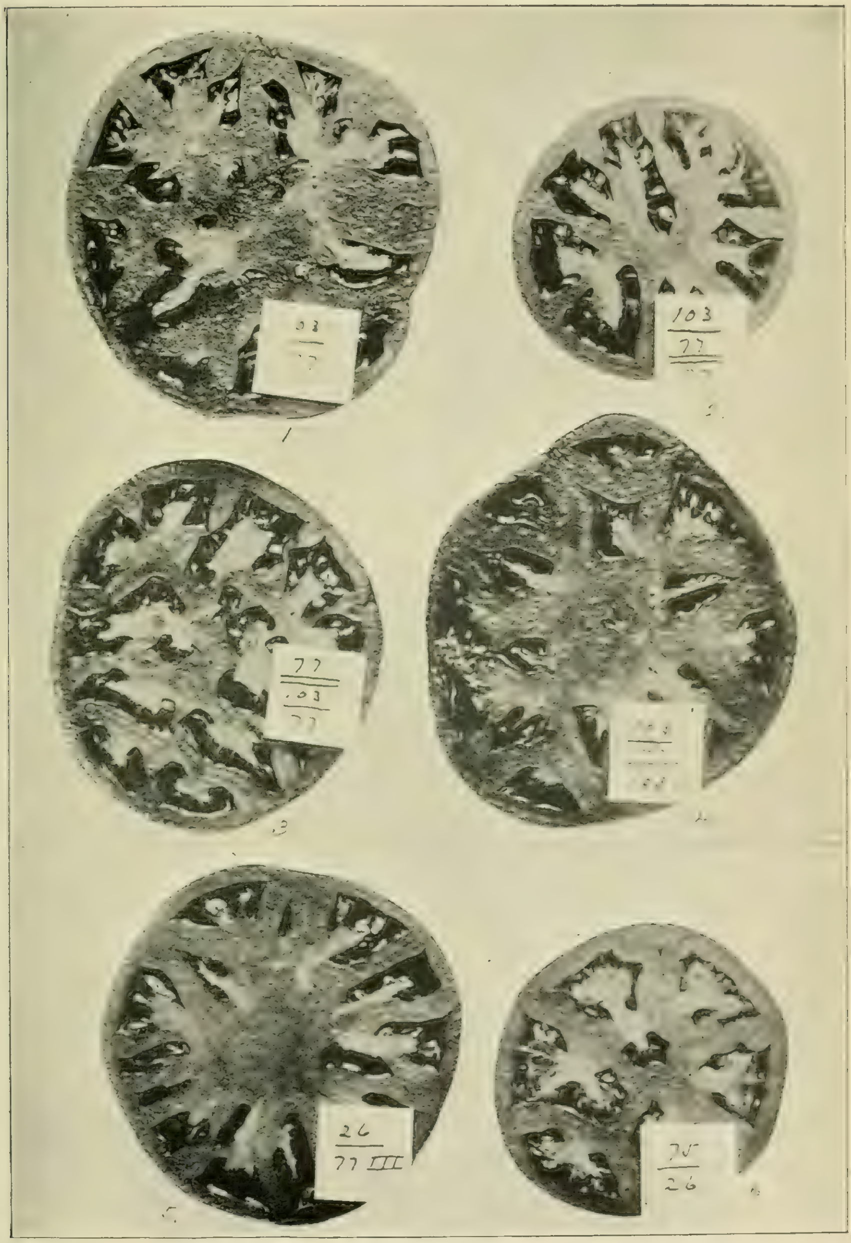
Several rows of two crosses between the "Marvel" (77) and the "Ponderosa" (103) have been grown during the season. The "Marvel" is red-fruited so that, in the cross with the "Ponderosa," a leading difference is in the color of the tomatoes. Another characteristic of note is the shape of the fruit, which in the "Marvel" is medium round and smooth and not over large. The "Marvel" is more nearly like the "Magnus" in form of fruit but differs from it in the color, while the foliage is not unlike the "Ponderosa." In short, in the cross under consideration, the unit character to be considered is fruit color and not type of foliage. The "Magnerosa" has a lingering outcropping of coarse-leaved plants with constant fruit color, while the present cross has the leaf type uniform with pink fruits appearing occasionally in the selected red strain.

The results of the "Marvel-Ponderosa" cross were so satisfactory last season that seeds were selected and several rows of the following combinations were grown the present year: (1) 103/77; (2) 103/77//77; (3) 77//103/77, and (4) 103/77//103. The first is a cross of "Ponderosa" (103) upon "Marvel" (77) represented by the fraction 103/77, that is, using the record number of the male parent as the numerator and of the mother as the denominator. The second combination is a result of the cross used as the male upon the "Marvel," the double parallel separating the parents in this union. The third is a cross of "Marvel" upon the original cross, and is styled a reciprocal of the previous (2) combination. The fourth is a union of the original cross with the "Ponderosa" as the female. The reader, from the position of the record numbers and the single and double lines, may quickly note the way in which the subsequent breeding of the "Magnus" and "Ponderosa" has been pursued.

A glance at the fruit sections in Plate VI. will help still further to give an idea of the fruits under consideration. The "slice" at 1 is of the primary cross as the fraction shows—which is upon a card, an inch square, to serve as a measure of the fruit slice. The endeavor was to select, as nearly as possible, an average typical fruit, but the photographing was unavoidably delayed until late in the season and the best fruits were all gone. The section at 1 is seen to be very "meaty," a strong characteristic of the "Ponderosa," and the seed cavities are much broken up and the seeds comparatively few. The fruit, as a whole, is a great improvement upon the "Ponderosa" because, with a much longer polar axis and therefore admitting of more slices, it is more nearly a circle in outline and but little grooved or ridged. This cross gives fruits that ripen quite early but the green shoulder is somewhat in evidence in otherwise mature tomatoes, suggesting the great defect of the "Ponderosa." The color is a pleasing red, but, if desired, a pink with all other qualities in common with the red may be easily secured and seeds in quantity of the pink-fruited strain have been secured.

At 2 is shown a section of a fruit of the second cross, as indicated by the fraction. This combination secures a medium-sized, smooth, apple-shaped tomato with the center less broken than in the original cross. The reciprocal of the last, shown at 3, produces a fruit of satisfactory size, form and smoothness with the wall thick and the interior thoroughly broken up and the red color uniformly distributed throughout the whole fruit.

By breeding the original cross, shown at 1, to the "Ponderosa" parent, a form of fruit is obtained that is not as desirable as in


03
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1
103
77
2
77
103
77
3
4
26
77 III
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75
26
6

PLATE VI.

Tomatoes. Four sections of fruits of crosses of the "Marvel" and "Ponderosa" - "Marvelosa. Below are two sections of crosses of the "Crimson Cushion."

the original cross because of the accentuation of undesirable qualities. A section of a fruit of this cross, which is three-quarters "Ponderosa," is shown at 4, and while the flatness is not evident in this view something may be seen of the irregularity of outline of the tomato. The center of the fruit is very fleshy and the area of seed cavity is correspondingly small. A three-quarter blood of the "Marvel" makes a more desirable fruit as to general form and size and evenness of ripening, and of this combination the one shown at 3 seems to be the nearest to the ideal, but of course, not attaining to it.

Reports from Testers of "Marvelosa" Tomato.

The seeds of this cross, 103/77, now named "Marvelosa" by combining the names of the two parents, were distributed as "Station Tomato No. 5" to thirty-nine applicants. From the reports submitted, the following extracts are given: "The plant is very strong and healthy, bearing good-sized fruit, smooth and perfect in shape and of a rich scarlet color." "Medium-size but very few small ones, a great bearer, very vigorous grower, no blight of any kind, shape round, color beautiful red when ripe, best of flavor and very fleshy; has very few seeds, one of the best for family use we ever raised; the soil in this place is none too good for tomatoes, but this one was fine." "Your tomato I think is fine, it is about the best I have ever grown." "Flavor excellent." " 'Tomato No. 5' we found very good, large, deep red; one measured sixteen inches in circumference; very prolific bearer; am more than pleased." "Tomato has shown a strong, vigorous growth throughout the season; the tomatoes are of good size, smooth and of excellent quality; I think they would be an excellent market variety." "Plants vigorous, beautiful color, excellent flavor, thin skin without tough core." "Plants very vigorous." " 'Tomato No. 5' proved worthy, was a good bearer, large size, had large seed cells; it may be classed as of good quality and a desirable acquisition." "Very productive and very solid and very delicious; the best we ever had." "The best of all the lot, large, perfectly smooth, vigorous, productive, an all-around grand tomato." "Each plant yielded from twenty-seven to thirty-two fruits each, uniform in shape and color; the height of each plant was about three feet and very stocky; the only fault about the fruit is that there is a hard substance in each fruit, otherwise they are perfect."

"Station No. 1."—"Arcadia-Earliana" (4/34).

A set of plants of the above cross was grown upon the Home Grounds and it proved to be quite satisfactory. The note book records the following facts: "Upon the 21st of June, the plants were in bloom; July 31st, very fine, large, red, smooth fruits with very little inclination to crack. Prolific—seed saved. August 22d, nearly gone. Medium early." There is a further note to the effect that the fruits are superior.

The seeds of this cross were sent to forty-six applicants, from whom the following observations have been received: "A prolific bearer and early, of a light red color, splendid flavor, all of a uniform size, plants are hearty and strong." "Season second early; it is a good general tomato." "Plants of 'Tomato No. 1' are vigorous and productive and of good quality." "Extra good shape." "I have had some very fine fruit from them and think them of merit; I think they are an all right stock." "They are a very fine tomato, the plant is of upright growth and a very vigorous grower, having as high as thirty to thirty-five fruits to a plant of delicious flavor with few seeds." " 'Tomato No. 1' had an exceptionally heavy crop; the vines were comparatively small but set heavily with fruit of good size and very uniform; flesh quite firm."

"Station No. 2"—"Arcadia-Cumberland" (4/28).

The set of plants of the above cross in the Gardens gave only medium quality of plants, that is, too small and feeble and, therefore, so far as this year's test is concerned not favorable.

Reports from those who had seed for testing run as follows: " 'Tomato No. 2' is very productive and very vigorous and for size it will be very hard to beat, in fact, it is the best I have received." " 'Station No. 2' tomato is a very fine one in every way, in fact, I have not seen anything in the way of tomatoes that is so uniform. It is a fine tomato and, by good treatment, will grace anyone's garden." "Am well pleased with this tomato; not inclined to rot as some other varieties." "Large size and healthy vine." "Very nice for table use."

"Station No. 3"—"Magnus-Crimson Cushion" (75 26).

The fifteen plants of the above cross in the Gardens were of large size and great vigor and showed the two types of foliage as expected, that is, fine-leaved and coarse-leaved in the seed flats and some of each type were set. There was also a representation of better colors of fruit, also expected, but not detectable until maturity was reached. In size and shape, the fruits are quite desirable and the vigor of the vines and their productiveness make this cross very promising for medium crop. The general structure of the interior of the tomato is shown at 6 in Plate VI., but in this case the fruit is under size and is shown in company with sections of those that are somewhat larger than the market demands.

Out of this cross, four strains may be obtained because of the two types of foliage and also of colors of fruits which entered into the combination.

The reports from the twenty-two testers are as follows: "Large and strength good, is very productive and the uniformity is good." "Plants are vigorous and productive and of fair size." "Good quality." "Fine quality and the nicest tomato we have had yet." "Very fine plants and sweet to eat like peaches."

"Station No. 4"—"Crimson Cushion-Marvel" (26 77).

The good results of the previous year with the above cross were repeated upon the Home Grounds during the present season. Upon June 28th the record book shows: "Large, fine plants," and later on, from time to time, the notes show only words of commendation. At 5, Plate VI., is shown a section of fruit of the third generation. Its center is a solid flesh of satisfactory texture and color. This is an improvement on the " Crimson Cushion," which is apt to be irregular and always too flat, approaching the serious defects of the "Ponderosa" among the red-fruited sorts. By breeding the "Marvel" to this cross, fruits are obtained in which the solid pulp center is broken and numerous seed cavities are scattered throughout the tomato. At the same time, the fruit is elongated, that is, its flatness overcome with some loss in size. This cross, as it combines so much of vigor and fruitfulness, is full of promise for a medium crop.

The seeds were distributed to fifteen applicants, some of whom have reported as follows: "Good healthy plants, yielding a good crop, medium early, believe they would do well in this section." "Vigorous grower and my plants are very heavily loaded with large-sized fruit." "Produced fine large fruits." "This tomato proved very successful and of very fine flavor."

"Earliana-South Jersey" (33/119).

In point of earliness, nothing among the crosses has been superior to the combination between "Earliana" and "South Jersey," both low-spreading sorts with red fruits. Four rows of fine plants were grown, namely, the "Earliana" upon "South Jersey" for the first and second generations and the reciprocal for the same generations. The two parents are quite similar in earliness and in productiveness, the "South Jersey" being somewhat ahead of the "Earliana." The former produces a large, flattish fruit that is not as smooth as the "Earliana," but ripens more evenly. The four rows were all nearly alike in characteristics, and therefore they did not furnish any clue as to the most desirable combination of the parents. They also indicated that no great variation might be expected in later generations. Seed was saved and some of it may be offered for testing, while a further trial is anticipated upon the Home Grounds.

"Bright and Early-Nolt's Earliest" (14/94).

The first and second generation of the above cross was grown with the result that the plants came early into bearing and the fruits were of fine shape and color but not quite large enough for the general trucker. For home use, where a medium-sized, bright red, "apple"-shaped fruit is desired, this cross would be acceptable, and for forcing it would seem to leave but little to be desired.

"**Fortune-Earliana**" (53/33).

The "Fortune" is a variety that has made a good record in its crosses for the past two years. The plants, as a rule, are large and strong and medium as to time of bearing the crop. A combination with the "Earliana," in which "Fortune" is crossed upon the hybrid of "Earliana," is shown at 1 in Plate VII. It is seen that the interior is quite solid and yet is somewhat broken by the seed cavities. The wall is of good thickness and the fruit is large enough, as indicated by the label (an inch square) bearing the record numerals of the kind and character of the cross. There was some variation among the plants as to the smoothness of the fruit and seed was saved only from the most desirable.

"**Giant-Ponderosa**" (56/103).

The cross between the two varieties named above, as expected, gave very large, long vines and fruits undesirably large and irregular. The notes show that the fruits were an improvement upon the "Ponderosa," but the only excuse for growing this cross would be that of a desire to see how large a crop could be produced. The ground, late in the season, was literally covered with the enormous misshapen fruits. The first of the two fruits of this cross, shown in sectional view at 2, is of the second generation as indicated by the Roman numerals upon the label, while the next slice-view (3) is of a specially selected plant (*c*) of the previous year. The second varies somewhat from the first in having the large center less broken by small seed cavities. It is not unlikely that this cross will be useful in breeding for solidity and comparative seedlessness, but, in itself, it is not desirable except for an enormous crop.

"**Honor Bright-Fortune**" (60/53).

Somewhat similar to the fruit of the "Fortune-Earliana" is the one in slice-view shown at 4, where, as shown by the label, the "blood" of the "Fortune" makes up three-quarters of the whole. The five plants were all stout, showing none of the yellow foliage common to the "Honor Bright" and bore a large, late crop of red, flattish fruits. In this cross, the seed cavities are large as compared with the cross last described but superior to it in length and smoothness as well as color of the fruit.

"Magnerosa" (75/103).

A fair sample of this new variety of Station tomato is added here (5) by way of comparison and to show an average fruit in its third generation upon the Home Grounds. The broken center is well shown in the section, as also the thickness of the wall and number and size of the seed cavities.

'Magnerosa" upon "Aristocrat-Extra Early Tree" (75/103//171/159)

By combining the "Magnerosa" with a cross of "Aristocrat" upon "Extra Early Tree," a set of plants was obtained showing much variability. The fruits were large but too irregular (6) and, coming late in the season, were not especially desirable. It remains to determine what careful selection may be able to bring out and fix in this combination. The breeding together of more than two varieties is usually a loss of time and trying to the patience.

"Ponderosa-Duke of York" (103/32).

Two rows of the cross of "Ponderosa" upon "Duke of York" were grown the present season and all the plants were of large size and produced much fruit during the middle of the season. The tomatoes were too large and irregular for the market. The flesh was of a fine pink color and the small seed cavities were scattered through the center, making a solid fruit (7). It is likely that, by breeding, the undesirable features may be removed and a fine variety secured.

"Stone-Best of All" (121/12).

At 8 is shown a slice-view of the above cross, which is not an entirely satisfactory fruit because of its medium small size. There were, however, some very superior tomatoes and somewhat earlier than the "Stone." The color was a very desirable bright red. By selection for greater size this cross may prove acceptable.

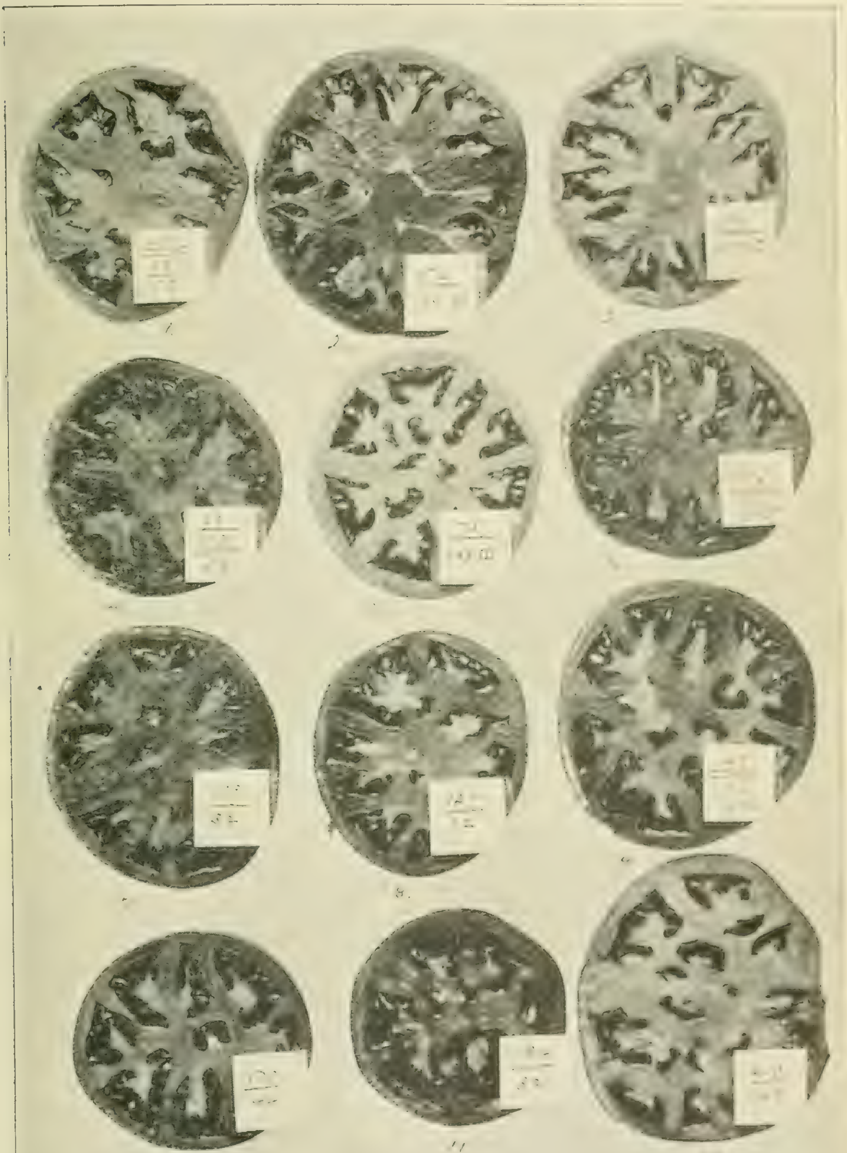


PLATE VII.

Tomatoes. Twelve sections of fruits of various crosses of Tomatoes

"Aristocrat-Lemon Blush" (149/147).

The above cross is between a red-fruited dwarf ("Aristocrat") and a yellow standard sort. Only the standard plants were selected from the seed bed for setting in the field. The "Lemon Blush" is remarkable for its great vigor and healthfulness of vines. The five plants all chanced to be red-fruited and, therefore, as to type of plant, standard and color of fruit, there was uniformity. The row was a good one and the fruit section shown at 9 is a fair sample of the whole and presents to view a well disposed center and a thick wall, while in shape it leaves but little to be desired.

"Dwarf Stone-Enormous" (170/44).

Upon "Visitor's Day" (August 17th), when several hundred persons interested in crop-growing viewed the Garden, there was no row of plants that received more favorable comment than that of the "Dwarf Stone" upon the "Enormous." Many other crosses were past their prime but this was at its best. The plants were all of the standard type, the dwarfs (about one-fourth in all such crosses) having been discarded when the others were removed from the seed bed. Perhaps the leading feature of attraction was the fine bright red color of the fruits, combined with satisfactory size and smoothness. The center of one of the fruits is shown at 10 and it is seen to lack somewhat in solidity, but there is an entire absence of any hard green core, so objectionable in some varieties. It is too soon to judge of the merits of this cross but it may be offered for a general test. Of course it is not an early tomato.

"Globe-Duke of York" (194/32).

The "Globe"—a novelty sent out in 1905—was bred to several varieties last year and these crosses have been studied the present season. A fruit slide of the above cross is shown at 11, but it does not do full justice to the cross because of lack of fruit when the photograph was taken. The "Globe," as the name suggests, has a fruit with a long polar axis and the combination with the "Duke of York" did not materially improve the center. In vigor and productiveness of plant, the cross is satisfactory and the color, following both plants, is of course a pink. There were other crosses with the "Globe" that give more of promise.

"Station Yellow-Dwarf Stone" (210/169).

Only two plants were grown of this cross, both of which were dwarf, following the parents—but in color of fruit one was yellow and the other red. The tomatoes, aside from color, were alike and quite satisfactory—the interior being a blending of flesh and small seed cavities, as shown at 12 in Plate VII.

Some of the "Globe" Crosses.

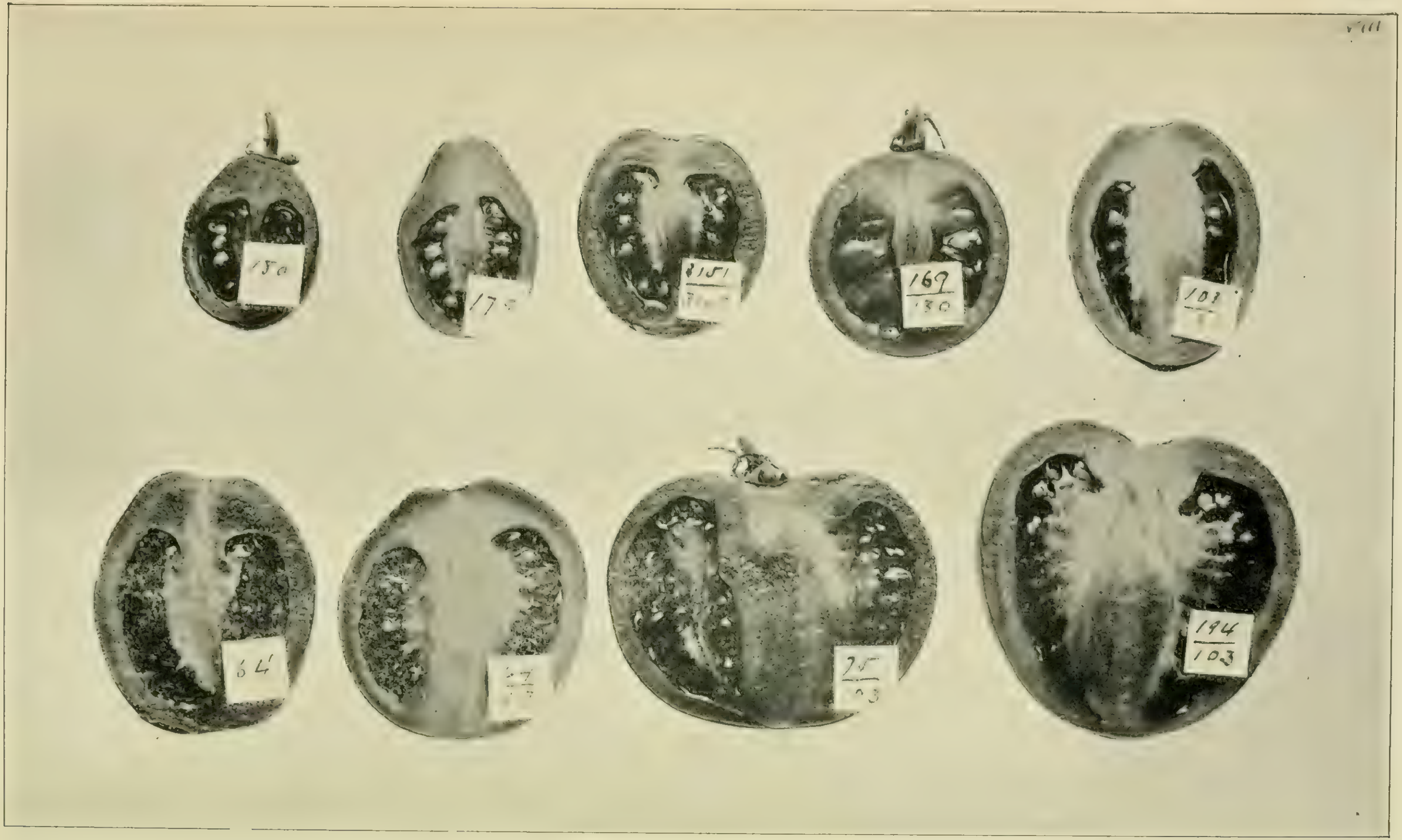
The "Globe" was crossed upon the following varieties last year: "Brinton's Best," "Duke of York," "Imperial," "King Humbert," "Magnus," "Ponderosa" and "Alice Roosevelt." This block of crosses, with the male parent in common, gave promises of results that will be announced later. With the exception of the "Duke of York," all the crosses were grown for the first generation in the greenhouse and, therefore, in the field the past season the first and second generations were grown side by side in parallel rows.

The "Globe-Brinton's Best" (194/15) cross for the first generation gave long vines, four of which bore red, and one pink, fruits. In the second generation, the plants were practically the same, namely, two with red and three with pink fruits. Out of this cross, there may be two strains separated, upon the basis of fruit color. The fruits were long, to which the term "apple-shaped" is temporarily applied.

The "Globe-Imperial" (194/63) gave three red and two pink fruited plants for both the first and second generations. Here the vines showed much length, were prolific and the fruits solid "apple-shaped" and somewhat late in maturing.

In the "Globe-King Humbert" (194/64) cross, the fruits were a very long plum in both generations, not easily distinguished and all were red.

The "Globe-Magnus" (194/75) cross gave strong plants, only the fine-leaved type being grown and the long fruits were all of the pink color.


VIII
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169
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194
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64

PLATE VIII.

Tomatoes. Fruits selected from plants that exhibited the desirable feature of a long polar axis.

A variable set of strong plants was produced in the "Globe-Ponderosa" (194/103) cross and here the shapes of the fruits were full of interest. Some were flattish and rough like the "Ponderosa" parent, while others were "apple-shaped." A longitudinal section of one of the tomatoes, showing considerable length of axis, is seen at 9 in Plate VIII. In this plate, the label is a half-inch square and several examples of tomatoes with a long polar axis are given, as follows: 1, "Red Plum" (180); 2, "Red Pear" (179); 3, a cross between two long-fruited kinds from Italy (3151/3047); 4, "Dwarf Stone" upon "Red Plum" (169/180); 5, "Ponderosa" upon "Sumatra Fig" (103/181); 6, "King Humbert" (64); 7, "King Humbert" upon "Fortune" (64/53); 8, "Magnerosa" (75/103), and 9, "Globe" upon "Ponderosa" (194/103), mentioned above.

"Red Currant-Dwarf Champion" (177/154).

The above cross is a very violent one because it is between two species, the "Currant" and the common type of tomato, and, secondly, the former is a standard of a very fine-leaved group while the latter is a dwarf. The blend resulting from the cross was grown in the greenhouse and from seed of this the twenty plants were raised, from which selections were made for the types shown in Plate IX. The spray, shown at 1, might be mistaken for the true "Currant," but upon close inspection, there are sufficient evidences of the cross. At 2 the foliage is seen to be approaching that of the ordinary standard fine-leaved type. Through 3 the type changes somewhat abruptly in 4, in which the stems are upright for a time and afterwards bend over clumsily because of the great length of the stems of these crosses. The leaves are, perhaps, the most different from the ordinary "Currant" type, they being short with the divisions broadened and strongly curled downward and inward. The extreme type of the crosses is seen at 5, in which the foliage of the mother plant is most nearly approached. These plants, four out of the thirty, were nearly upright, comparatively short-stemmed and may be classed as dwarfs although the axis of the plant is longer than a dwarf of the common sorts of tomatoes.

In fruit the variations were not great, all plants producing clusters somewhat after the "Currant" type, but shorter, with the tomatoes of the size of large cherries. It was observed that some plants produced fruits that averaged larger than those of others, while six were pink, following the "Dwarf Champion" parent, and the other fourteen were red, like the "Currant."

There is, perhaps, but little of practical value in the results of this cross. The dwarf forms may serve as useful plants for producing small, neat fruits in great abundance for pickling or where a small, round tomato may be of special use. Seed by inbreeding was obtained from these plants.

It was observed that the flea-beetles, and possibly other insects, were more apt to eat the foliage of these crosses than that of the ordinary sorts.

Narrow-Leaved Tomato Plants.

Several plants of the "filiform" type of foliage were found among the crosses the present season. These agree, in general, with those that were first noticed the previous year and noted in the Report (1905) upon page 472. These plants are peculiar in having the expansions of the leaves reduced to narrow threads, not much more than the main veins remaining. The general appearance of a spray of a filiform plant is shown upon the right side in Plate IX. Frequently the terminal portion of the leaf is broader than any other similar portion, giving a strange aspect to the plant. The flowers partake of the slender, elongated nature of the foliage, and are therefore somewhat longer and very much narrower in the envelopes than the common blossoms. They form the most striking variation that has been observed in tomato flowers, which, as a rule, are quite constant.

The plants showing this type of leaf are not fruitful, and do not seem to be of any practical use. Seeds have been obtained from inbred plants that the peculiarity may be further studied as to its persistence and effect when bred with the ordinary kinds.

TOMATO PLANTS FROM CUTTINGS.

Cuttings were taken from several of the most acceptable tomato plants that were grown in the greenhouse and placed in the garden. The following is the list, with occasional comment:

"Atlantic Prize-Washington" (7/212) gave one plant, not thrifty.

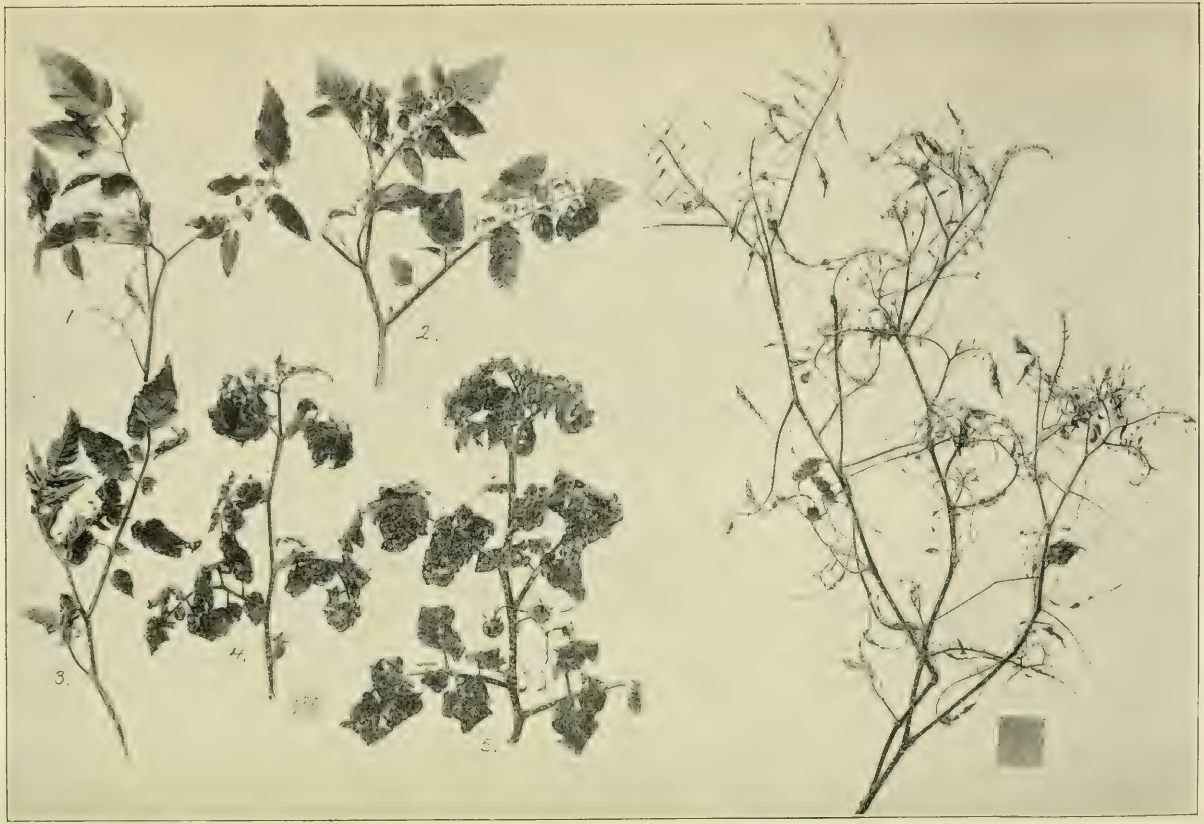

PLATE IX.

Tomatoes. Five types of foliage in the crosses of "Red Currant" upon "Dwarf Champion." To the right is a spray of the "filiform" type of foliage.

"Beauty-Fortune" (8/53) gave fine, high-colored (red), uniform fruits.

"Bright and Early-Nolt's Earliest" (14/94). The fruits were uniform upon all the plants, but a trifle too small for field culture.

"Cumberland-Dandy Dwarf" (28/158). The foliage of these plants was of the yellow type, and strengthened the opinion that it is not as good as the ordinary green kind.

"Earliana-Jewel" (33/66). This proved undesirable because of undersized fruits that cracked.

"Giant-Ponderosa" (56/103). Here the plants and fruits were all of the same type, but the latter were too large and irregular.

"Giant-Globe" (54/194) produced a large number of large fruits, but late in the season.

"King Humbert-Fortune" (64/53). These plants, while uniform in all respects, showed too much of the "Humbert" blood to be of much value.

"King Humbert-Giant Climbing" (64/57). In itself, not worthy of culture.

"King Humbert-Ponderosa" (64/103). Very productive, but the fruits were long and flabby.

"King Humbert-Lemon Blush" (64/147). Undesirable, but may be of value as a breeder.

"Magnus-Crimson Cushion" (75/26). A fine set of plants, uniform in all respects. This meritorious cross is reported elsewhere.

"Magnus-Earliana" (75/33). This gave uniformity in vine and fruit, the latter being of desirable form and color.

"Magnus-Dwarf Champion" (75/153). This was a set of the dwarf type of uniform character and excellence.

"Magnus-Dandy Dwarf" (75/158). The green foliage type of plants was represented and proved of only fair fruitfulness.

"Magnus-Alice Roosevelt" (75/188). This cross, throughout the cuttings, grew uniformly strong plants with "apple-shaped" fruits.

"Ponderosa-Duke of York" (103/32). The plants were uniformly large-sized but the fruits lacked desirable qualities.

"Potato Leaf-Minnesota" (104/87). The fruits were too small for field culture.

"South Jersey-Bright and Early" (119/14). The plants were medium and the fruits fair, red and smooth.

"South Jersey-Earliana" (119/33). The plants did well and the crop was early and satisfactory.

"Stone-Brinton's Best" (121/15). This even set of plants gave fine large fruits.

"Dwarf Stone-Imperial" (170/63). The plants were all poor.

"Dwarf Stone-Golden Queen" (170/144). The uniform plants were strong, of the standard type with very firm, bright red fruits.

"Alice Roosevelt-Imperial" (188/63). This was a poor set of plants.

"Globe-Brinton's Best" (194/15). This gave a set of plants with red, smooth fruits.

"Globe-Duke of York" (194/32). The fruits were large, pink, "apple-shaped," but not regular.

"Globe-King Humbert" (194/64). This gave a long, flabby fruit.

"Globe-Magnus" (194/75). A set of strong plants, all fine-leaved and pink-fruited.

This experiment strengthens the belief that blocks of tomato plants may be easily obtained from cuttings that will be extremely uniform, and, until varieties are more stable than at present, it may be desirable to thus secure fancy crops of the very choicest types of plants of any selected kind. It is a treat to the grower to be able to fill his baskets or wagons with fruits that vary no more than do those from any one plant that approaches the ideal tomato.

The fact of nearly absolute uniformity in shape and color and approximately so in size is one that appeals to some truckers, as it does strongly to the fastidious consumer, and, through the method of making cuttings, the way is clear to an increased pleasure, if not of profit, in tomato growing.

GENERAL REMARKS UPON TOMATO EXPERIMENTS.

There were two hundred and eighty-four crosses, five plants each (with few exceptions), grown the present season, not including thirty-six crosses from cuttings taken from the greenhouse plants. Representatives were in quantity of standard and dwarf types of plants; fine, coarse and yellow sorts of foliage; red, pink, yellow and "white," smooth and hairy (fuzz) fruits.

The standard plants have, as a rule, done better, but perhaps in a soil more congenial to tomatoes the dwarfs might be as preferable. The latter, being smaller, may be planted much closer and permit of horse tillage where the standards spread and interfere with the cultivator or plow. Certain of the dwarfs did remarkably well, giving some of the finest fruits that were grown. The test, in continuation of the "Magnerosa-Dwarf Champion" (75/153) crosses, offered an opportunity to study the subject of size and type of foliage at the same time. Rows were set with plants of the following four possible combinations: (1) standard fine-leaved; (2) standard coarse-leaved; (3) dwarf fine-leaved and (4) dwarf coarse-leaved. The rows were side by side, and, as far as possible, the same conditions prevailed with all plants as to time of seed-sowing, transplanting and field culture. The dwarfs were given the same ground space as the standards, which was to their advantage. Under the above-named circumstances, the general conclusion was that the standard fine-leaved plants were superior and the relative merit of each of the four groups is expressed by the order in which they are given above. This corresponds with the report of the same test made last season, and therefore one year earlier in the history of the development of these four types from the single mother fruit. Where the dwarfs are set a half more to the acre than the standards, it is likely that the yield will equal that of the standards for any given area. The fruits upon the dwarfs vary less in size than upon the standard plants, that is, they are neither as large nor as small, and in this respect are superior. Again, the dwarfs are more apt to bear the fruits up from the ground, and are therefore more perfect in exterior and somewhat better flavored. When a dwarf "falls over," it makes a one-sided plant that is much less shapely than the standard and more apt to get broken off near the root. A single stout stake would help to hold a dwarf in place much better than a standard that is not pruned to a single stem, in which case the latter would become tall and troublesome.

The yellow foliage was more or less in evidence in nearly all the crosses where it is a parental characteristic. In a double combination of "Honor Bright" (with yellow foliage) and "Fortune" upon "Fortune," in which, therefore, the "Honor Bright" is represented by one-quarter, there were no yellow-leaved plants among the five of the row. But in the cross of "Honor Bright" with

"Frogmore," there was one of the "sickly" yellow plants to four of the usual green type. Among the "Princess" crosses, comprising twenty-two plants, there was only one that showed the peculiar foliage in question, but this one was strongly marked and indicates that the characteristic may be expected to appear in small numbers for an indefinite time in crosses where one parent is "yellow-leaved."

Concerning the color of the fruit, it is not easy to state the results of the observations in a few words. The reds, pinks and yellows are fairly constant, and all attempts to develop intermediates have been failures, excepting that, for example, the "reds," so-called—which are, in fact, a dark orange mixed with red—have in some instances lost all of the red and developed pure orange fruits. Seeds from these orange fruits do not give fruits after their kind, but the old mixture of colors. When the "reds" and "pinks"—which differ from the "reds" in having less orange—are bred together, the offspring are easily arranged under the two parental colors, one-fourth being "pinks." Here, again, there are slight modifications.

With the yellow color there is more hope of getting a combination with the reds and the striving after a deep blush upon a yellow background, like a peach in its perfection of color, may not be in vain.

The so-called "white"-fruited sorts have been grown only to a limited extent, and the crosses obtained are few. Thus the "Ivory Ball," in combination with "Duke of York" (32/175), in its second generation, gave three plants with pink fruits, like the male parent, and two with very pale yellow fruits, styled "whitish lemon" in the note-book record. This last is quite different from the mother fruit, which does not show the yellow. A similar result was obtained with the "Aristocrat," three of the plants giving light yellow fruits, while two were red, but, most interesting of all, showing the yellow as blotches upon the surface. When the "Gold Ball" is bred with "Ivory Ball" (172/175) there results in the first generation a fruit that is of a lighter yellow than the male. In the next generation the same lighter color is retained as a constant average between the two parents. In the cross with "Yellow Cherry," the "Ivory Ball" (175/183) produced a pale yellow fruit of the size of the "plum," and again reduced the amount of yellow in the fruits. The same peculiar lemon color was uniformly retained in the next generation.

Nothing has been done directly to study the peculiar fruit coat that is characteristic of the peach. In the cross of the "1903" with the "Quarter Century" (143//165/143) the "peach" surface was apparent upon the tomatoes of four out of five plants, and in this respect followed the male. It should be said that the "1903" blood in this instance is represented by the fraction ¾. The results of previous observations lead to the opinion that the fine hairiness upon the fruit is not expected upon more than a quarter of the plants in the first generation, after the blend, when one parent has that characteristic.

EXPERIMENTS WITH EGGPLANTS.

During the present season, the area devoted to eggplants has been chiefly occupied with crosses between the several varieties, and, necessarily, but little space was given to the parent sorts. A comparatively full list of the commercial varieties that have been grown, with partial descriptions of the same, are given in the Report for 1905, pages 485-492. There were only a few representatives of the "Jersey Belle" upon the Home Grounds. Packets of the seed of this sort were distributed in the winter to two hundred and twenty-six (226) applicants, nearly all within the State, and from their reports the following extracts are made.*

Reports upon the "Jersey Belle" Eggplant.

"This eggplant is very large and productive for an early sort, good purple color, well shaped, some slight variation as to type." "Would say my 'Jersey Belle' eggplants are the finest I or any of my neighbors ever saw. They stand three and four feet high, and are very bushy. The stems are a very dark purple, also the fruit. I picked my first the twenty-first of July and it measured twenty-three inches around and twenty-six the long way. They are perfectly smooth, and some plants have seven and eight on them." "They are good bearers." "Plants vigorous, some stocky, others of taller growth." "All are of good quality." "Free from disease." "The seed I received produced very large eggplants of good purple color and well shaped." "Two or three fruits on all plants." "The fruit is of good shape and size for slicing." "The plants are large, stocky and vigorous, and the leaves dark. The fruit varies from long to half-long, quality the best. I consider it worthy of general cultivation." "I think it a variety worth keeping, as they started easily when little plants." "It has met all one could expect, and at the present time is doing nicely; the size is good, and it is very productive; we have never had such very good success with eggplants, but this is as good or better than we have ever had before." "Color very fine." "The 'Jersey Belle' is doing finely; a quick, vigorous grower, setting fruit nicely; earlier than the 'New York Improved,' set at same time; I think it a very promising variety." "The eggplant has continued to bear fruit liberally, some being quite long, others similar to 'New York Improved;' it is a very desirable sort, being earlier with me than any other I have." "It is thirty-three to thirty-seven inches in height; vigorous grower; three to six fruits at once, with crowded blossoms all over plant." "We are much pleased with the 'Jersey Belle;' we are growing the 'New York Improved,' and I notice the superior shape of your plant, it being more of an ideal shape for slicing; it seems to be a hardy, vigorous grower, and we hope to produce more of its kind next year." "I succeeded in raising fine plants; the fruit is five to six inches long, three to four inches thick, and one plant has three of this size and five smaller ones." "The 'Jersey Belle' eggplant is growing finely; in the bed from the seed you sent me there will be a reversion to the parent stock of about 20 per cent., largely of the long purple variety; the true type, however, will be attractive in appearance and a fine grower; color, dark purple; very quick in maturing its fruits; I am inclined to think it will be the earliest of the large varieties; plant a vigorous grower, and about as productive as 'New York Improved.' " "The 'Jersey Belle' is an entire success; the plants are about two feet high and very vigorous; they are loaded with fruits and blossoms; plants very uniform in shape; fruits exceedingly fine." "The eggplant is satisfactory; it is a vigorous grower and has large fruits; flavor good." "Flavor of fruit unusually good; better than the large variety I have." "A good plant and a good bearer."

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*Seedling eggplants are not as easy to grow as young cabbage plants, or even tomatoes, and this seems to be the reason for the failures, in some instances, to secure satisfactory plants. If the trial of these seeds has led growers to look more carefully to details in such matters in the future, the results marked failures will not be altogether without fruit.

The crosses considered below are arranged in the sequence of the numerals representing the male parents.

"Black Snake" upon "Dwarf Purple"—(2/5).

Of this cross seventeen plants were grown and all were thrifty and in full bloom by the middle of June. Later on, July 14th, it was noted that the plants were of medium height and full of fruit, showing that this cross is early and the plants are comparatively small. The record shows that eleven of the plants were decidedly dwarf while others were of nearly the standard size. All had purple foliage and stems with the same color for the fruits, which were long, pear-shaped and too small for the summer market. It was also recorded that the fruits did not decay as is the case with all of the more common sorts. An inferior sample of the quite uniform fruit of this cross is shown at 1 in Figure 1. As the photograph was taken very late in the season, the sample is not up to the average for this cross.

"Black Snake" upon "Early Dwarf Oval"—(2/6).

This cross gave a set of thirteen plants that were similar in all respects to the cross previously mentioned. Four plants were dwarfs and nine of the standard type. Fruits were produced early, as previously stated, and in very great abundance, held on without decaying throughout the season, but, unfortunately, are too small for the market unless they may be of particular value when grown in the greenhouse for winter use.

"Black Snake" upon "New York Improved"—(2/18).

This cross was represented by five plants, all of upright growth and with dark foliage representing two types, namely, those that were very tall and decidedly bushy and the dwarf type, there being three of the latter. The tall plants were fairly prolific and the dark purple fruit resembled the male parent in being quite long.

"Black Pekin" upon "Black Snake"—(3/2).

Nine plants of this cross were grown and they showed both parents in the tallness of the plants and the dark foliage and stems. All the plants came into bearing early and were comparatively fruitful. The fruits themselves were not large, quite elongated, somewhat curved and combined the characteristics of the two parents. A sample is shown at 2 in the engraving.

"Dwarf Purple" upon "Black Beauty"—(5/4).

There were ten plants of this cross, all of them large and excellent. Fine marketable fruits were in abundance on July 14th and were quite uniformly of the oval type shown at 3 in the engraving. There was a tendency on the part of the plants to break up into two types as to size, half being strictly standards and the other five of a more dwarfish nature. The foliage was unusually strong, the leaves being broad and green, as also were the stems. This is a promising cross.

"Dwarf Purple" upon "New York Improved"—(6/19.)

This cross showed strongly the blood of the "Dwarf Purple," giving a set of low, spreading plants with purplish foliage and stems. The fruit, of good size and produced in abundance, was of a handsome pear-shape, as shown at 4.

"Jersey Belle" upon "Black Snake"—(10/2).

This cross was represented by thirteen plants, all of them quite tall like the "Black Snake," with dark foliage and stems. The fruits were produced in abundance and had a long, cylindrical form, shown at 5, and varied as to the color, some of them being of a rich purple while others were inclined to be green and somewhat striped, as indicated in the engraving. This type of fruit is quite close to that of the "Station Eggplant No. 1," seed of which was distributed to a limited number at the beginning of the season.

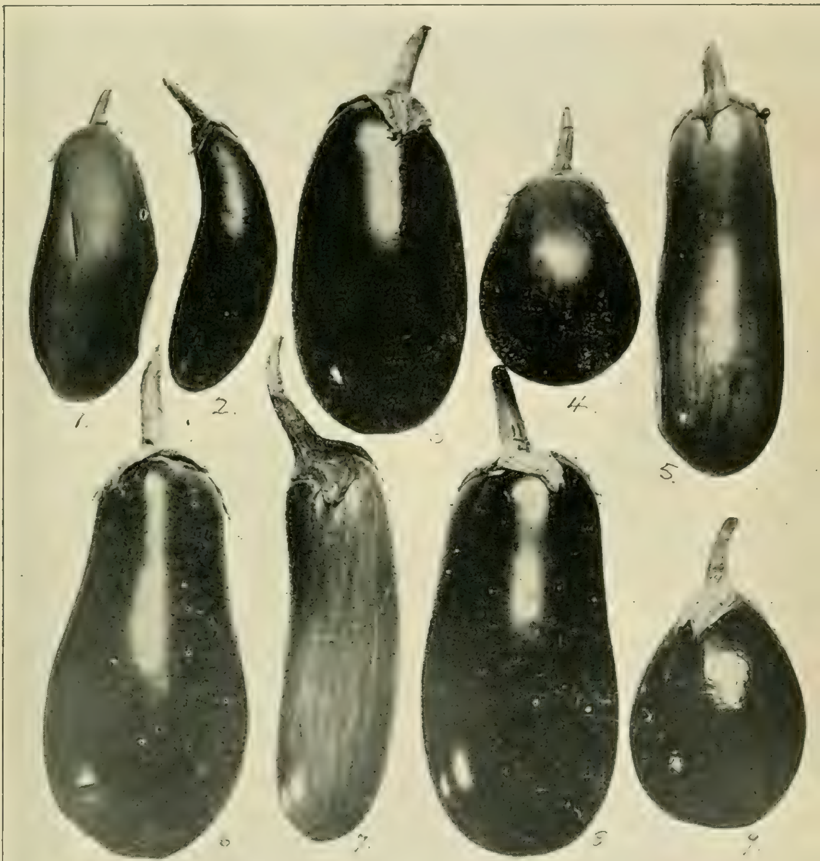

Fig. 1.

Crossed Eggplants. "Black Snake-Dwarf Purple" is shown at 1; "Black Pekin-Black Snake," 2; "Dwarf Purple-Black Beauty," 3; "Dwarf Purple-New York Improved," 4; "Jersey Belle Black Snake," 5; "Jersey Belle-Excelsior Tree," 6; "Long White-Black Snake," 7; "Long White-Black Beauty," 8; "Pride of Sunnyside-Black Beauty," 9

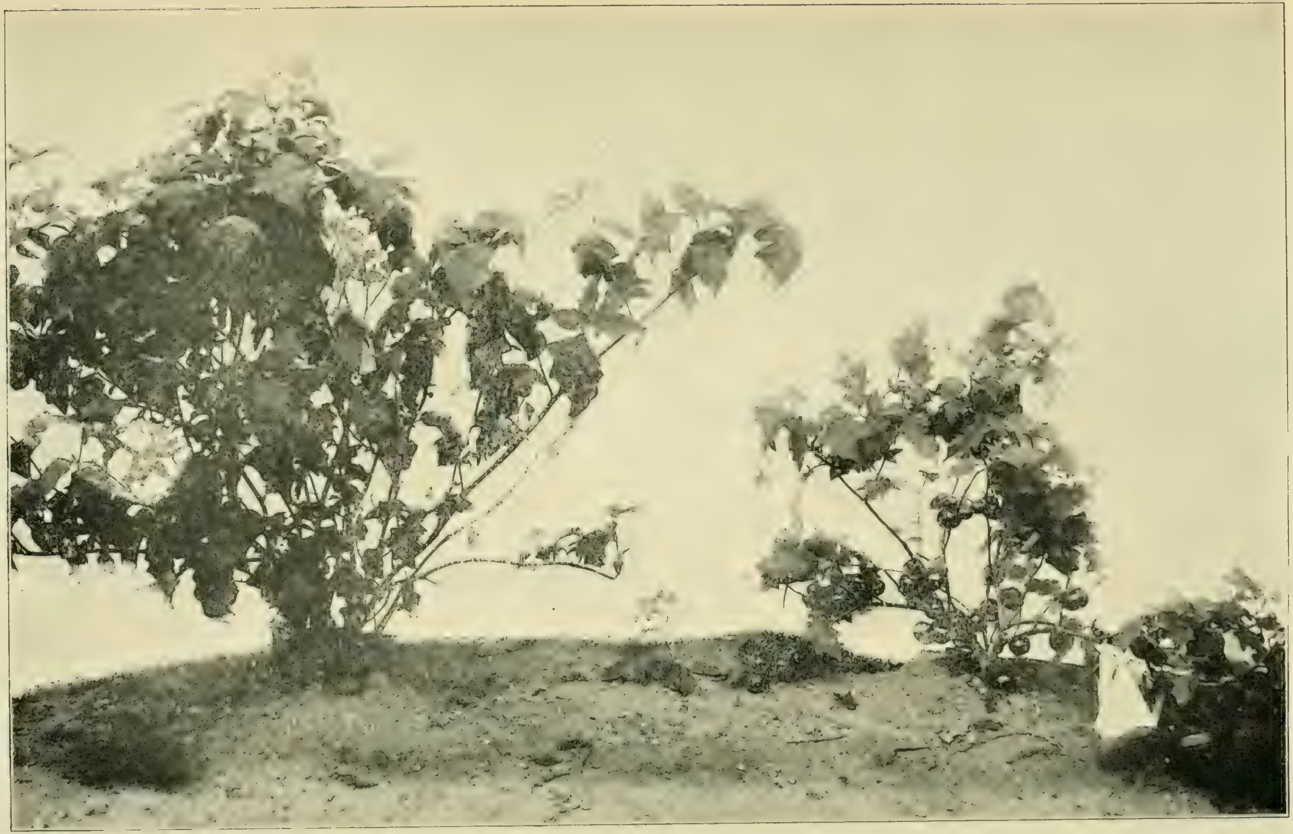

PLATE X.

Eggplants. Two plants of the Hybrids between "American" and "Chinese" Eggplants; the one upon the left is large and barren, and the right hand one is dwarfed and loaded down with the small, nearly smooth, fruits.

"Jersey Belle" upon "Excelsior Tree"—(10/7).

Only five plants of this cross were grown the present season, two of them being of the standard type with broad leaves showing, but little purple color in the stems and the fruits of particularly attractive form, a long bell with a rich purple color; the record book has underscored against this type of this cross the word "promising." A representative of the fruit is given at 6.

"Long White" upon "Black Snake"—(11/2).

There were ten plants of this cross and all of them were tall with purple in both leaves and stems. The long, cylindrical fruits were seasonable, some of them purple and others decidedly green, somewhat striped and turning yellow when ripe. The specimen shown at 7 gives some idea of the marking upon the fruit above mentioned. The plants of this cross were particularly noticeable because of their extra height and the long, slender fruits, borne in considerable numbers and which are particularly adapted for slicing.

"Long White" upon "Black Beauty"—(11/4).

Eleven very fine, thrifty plants of this cross were grown and attracted much attention on account of the large size and fine form and coloring of the fruits (8) which they produced. All the plants were green throughout in stem and foliage, of medium height, came into bearing promptly and held out through the long season, giving great promise for this combination. It is noted that the blend represented by this set of plants showed nothing of the color of the white parent, the fruits being of a particularly rich dark purple.

"Pride of Sunnyside" upon "Black Beauty"—(20/4).

The thirteen plants representing this cross were all of small size, rather broad-leaved, with purple color and foliage, and younger branches late in coming into bearing and not very fruitful. A sample of the fruit is shown at 9.

"Long White" upon "New York Improved"—(11.18).

In 1905 the third generation of this cross was represented by a block of thirty plants, as recorded in the Annual Report for last year. It was there stated that "seeds were saved from only two plants, and these were exceptionally fine in many respects, and agreed in having the many fruits—one seven and the other nine—of a delicate pink color when ready for the market." During the present season forty-five plants from the seed of the best plants above mentioned were grown in the Gardens. Upon July 9th the plants were in bloom and some variations were noted, and a week later it was observed that while some of the young fruits were a bright pink, others were entirely white. Later in the season it was determined by actual count that there were thirty-seven plants that bore pink and eight white fruits. The plants were quite uniform in size and character of foliage, with the leaves and stems of a strictly green color. The fruits themselves, borne in abundance, were long bell-shaped. The color varied among the pinks, some of them being dark and others decidedly light, so that further selection is much needed before a uniform fruit, in color and also in shape, is obtained. The type of plant, productiveness and desirable shape of the fruit all combine to make this cross one of decided promise. The small number of white throughout the plants suggests the Mendelian law, the pink color being dominant. In type of plant and productiveness, and in fact all other characteristics than the color, the white strain agrees with the pink sort above mentioned. Fruits were obtained by hand pollination, and there is hope of having a block of plants next year that will be entirely of the white strain. There remains one characteristic to be mentioned, namely, that the flesh of the fruit of this cross, whether pink-colored or white upon the surface, resembles that of the "snow" apple ("Fameuse"), and is decidedly attractive, giving this cross a characteristic that separates it readily from all other crosses grown in the Gardens.

HYBRID EGGPLANTS.

In 1904 a fruit was obtained upon the "Scarlet Chinese" eggplant (*Solanum integrifolium* Poir.), bearing seeds that were fertilized with the "Fordhook Improved" (*Solanum Melongena* L.).

This combination has taken the fractional record number, 14/25. Last season a single plant of the hybrid was grown, a description of which, with engraving of fruit sections, was given in last year's Report, pages 291-492. During the present season thirty-six plants, representing the first generation from the blend, were grown in the Gardens, a record of which, in tabular form, is given below:

Number of Plant.	SIZE.	COLOR.	FOLIAGE.	Spines.	Flowers.	Number of Fruits.
1	Tall	Green	Large, crinkled	None.	Few, white.	0
2	Medium	Purple	Small, smooth	"	Few, pink.	4
3	"	"	" "	"	" "	10
4	Small	"	Medium, crinkled	"	" "	3
5	Tall	Green	Large, crinkled	"	Few, white.	0
6	Large	Purple	Small, smooth	"	Few, pink.	4
7	Low	"	Medium, smooth	"	Many, pink.	0
8	Medium	Green	" "	"	Few.	3
9	"	Purple	Large, crinkled	"	"	12
10	Tall	"	" "	"	Few.	8
11	Dwarf	"	Small, smooth	"	"	3
12	Tall	"	Large, crinkled	"	"	7
13	Medium	"	Medium, crinkled	"	Few.	45
14	Low	Green	Large, smooth	"	"	12
15	"	Purple (light)	Medium, smooth	"	Medium.	3
16	Medium	Green	" "	"	"	5
17	"	Purple	Small, smooth	"	Few.	2
18	"	"	Medium, crinkled	"	"	9
19	Low	"	Long, crinkled	"	"	7
20	Dwarf	"	Medium, smooth	"	"	3
21	Medium	"	" medium	"	Medium.	20, small.
22	"	"	" "	"	Few.	3, very small.
23	"	Purple (Green)	" crinkled	"	"	2
24	"	" (dark)	Large, smooth	"	"	6, late.
25	Tall	" (Green)	" crinkled	"	"	5
26	"	Green	" smooth	"	"	3
27	Dwarf	Purple	Medium, smooth	"	"	30
28	Medium	"	Large, smooth	"	"	2
29	"	"	Medium, smooth	"	"	20
30	"	Green	Large, smooth	"	"	12
31	Dwarf	Purple	Small, smooth	Yes.	"	35
32	Tall	"	" crinkled	"	Medium.	30
33	Medium	"	Medium, smooth	"	"	40
34	"	"	" "	None.	"	4
35	Large	"	Large, smooth	"	Few.	5
36	"	"	" "	"	Medium.	0

The above table of the thirty-six plants, grown from seed from the single-blend plant of the previous season, shows several leading points in which the individuals differed from each other. The general terms as to size in the first column, when grouped, include the following number of plants: Large, 3; tall, 7; medium, 17; small, 1; low, 4; dwarf, 4. In other words, there were above medium, 10; medium, 17, and below medium, 9, or one-half were medium and one-quarter tall and the other quarter dwarfed. The record of color of stems and foliage shows that six were green, with three others with a combination of green and purple; that is, one-quarter showed green and three-quarters purple. The size and appearance of the leaves varied greatly, and do not admit of much grouping. There were 14 large, 15 medium and 7 small-leaved plants, and 22 with smooth leaves, 12 with crinkled foliage, and 2 that were midway between the two. There were only 3 of the plants with prickles or "spines."

The flowers varied somewhat in size, and those borne by purple plants were pink, while the green plants had white blossoms. As a rule, the flowers were numerous, but failed to set fruit. In this last point of fruitfulness there was a great range. There were four plants that produced no mature fruits, one of them being among the largest in the block. The four dwarfs gave an average of eighteen fruits, while the largest plant averaged only about three fruits. This condition of fruitfulness is well shown in Plate X., where a large and small plant are given, the former bearing no fruits and the latter thirty. The size, shape and color of the fruits upon any given plant were quite constant, but there were many variations upon the whole block. The fruits from the two parents are shown in the upper half of Plate XI., "American" at 1 and "Chinese" at 2, and sample fruit-bearing stems from ten hybrids are shown from 2 to 10, those at the left being more nearly smooth and most approaching the common garden parent. Many things are lost in the engraving, as, for example, color, which is uniformly orange, and therefore differing but little from the "Chinese" parent. The shade, however, varies, and in those fruits that are nearest "apple-shaped," as at 2 and 3, the color approaches lemon, and something like that taken on by certain garden eggplant fruits, as the "Dwarf Purple" when fully mature. The three fruits shown at 7 are larger than the "Chinese," but quite as flat, and deeply ribbed and like it in color. Many plants produced fruits that constantly were much smaller than the "Chinese" parent, and one plant produced a liberal quantity of fruits, nearly all of which showed a long, conical projection at the blossom end, specimens of which are shown at 9. These instances go to show that in this, the first generation after the blend, the "current," so to say, of the two commingled "bloods" is not flowing evenly, and one cannot feel certain of anything until more generations are grown.

It is, however, apparent that in the matter of the character of the fruit, the "Chinese" exerts a preponderating influence over the "American," but it is to be remembered that the large size of the fruits of the latter is a cultural development, and, so far as affecting the hybrid, it may be that the small-fruited wild type might have been as effective.

The matter of the lack of "spines," with the exception of three plants, is one of special importance, in view of the fact that both parents were "spiny," and, also, the blend plant that was grown last season.

A Derivative "American-Chinese" Eggplant Hybrid.

In 1905, a combination was secured between the above hybrid and the "Scarlet Chinese" parent, and is expressed by the compound fraction 25//14/25, the double line separating the two parts that enter into this second union. Twenty-four plants were grown, and below some of the characteristics are given in tabular form:

Number of Plant.	SIZE.	COLOR.	FOLIAGE.	Spines.	Flowers.	Number of Fruits.
1	Medium	Purple	Dark, smooth	No.	Few.	24
2	“	“	“ “	Yes.	“	27
3	“	Green	“ “	“	Many.	12
4	Large	Purple	Large, smooth	“	Few.	7
5	Medium	Green	“ white	“	Few, large.	15
6	“	Purple	Smooth	No.	Few.	3
7	Low	“	Purple	Yes.	Many.	24
8	Medium	“	Oak-leaf	No.	Very many.	9
9	Giant	Green	Long, crinkled	“	Few.	0
10	“	Purple	Large, smooth	Yes.	Many.	0
11	Medium	“	Long, smooth	“	Few.	12
12	Tall	“	“ “	“	“	9
13	“	“ (Green)	Medium, smooth	“	“	6
14	Medium	Green	“ “	“	“	27
15	“	Purple	Long, crinkled	No.	“	24
16	Low	“	Smooth, crinkled	“	Many.	2
17	Dwarf	“	Medium, smooth	“	Few.	27
18	“	“	“ “	Yes.	“	30
19	“	“	“ “	“	“	25
20	Medium	Green	Long, smooth	“	“	10
21	Large	Purple	“ “	“	“	2
22	“	“	“ “	“	“	5
23	Medium	“	Medium, smooth	“	“	12
24	“	“	Long, smooth	No.	“	29

In size there were seven above medium, eleven medium and six low, or dwarf. The color of foliage shows that there were eighteen with purple stems and leaves and six that were green (one having some purple). Some omissions in the notes upon the foliage render it impossible to get the number of crinkled and smooth-leaved plants. Sixteen of the plants were with “spines” and eight without them; five were profuse with bloom in late autumn and nineteen bore but few flowers. In number of fruits the range was from none to thirty. The seven plants above medium size averaged four fruits and the five below medium had one hundred and ten fruits. The two dwarfs bore fifty-seven fruits while the two "giants" were entirely barren. In this set of hybrids there was a direct correlation of fruitfulness and small size, besides it was the dwarfs that produced the largest and finest specimens of fruits.

If, by further experimentation, it is found that the dwarfs continue to be small-sized and fruitful, it will suggest that this characteristic type of plant may have its origin in breeding even when the parents are of the standard forms.

"Pride of Sunnyside" upon "Scarlet Chinese"—(20.25).

This set of fourteen plants was most remarkable in its vegetative power, producing enormous plants five and more feet high and proportionately broad, the leaves being uniformly quite large and slightly tinged with purple. As a whole, these two races of giant plants were nearly fruitless. The specimens that were obtained at the close of the season were usually smaller than those of the "Chinese" parent. The plants were extremely thorny, more so than any other hybrids that have thus far been grown, and exceeding to a large extent the spinose nature of the "Chinese" parent. One peculiarity, noted in this hybrid for the first time, is the pinkish color of the young, growing fruits, this color being held until near maturity, when it is displaced by a dull orange resembling slightly that of the "Chinese" parent. This color is evidently taken from the "American" eggplant, as it agrees perfectly in shade with those of our ordinary purple eggplants. In the lower half of Plate XI. is shown a collection of the fruits of this hybrid from eighteen plants at different ages of maturity in contrast with the "American" parent upon the left hand (1), while the "Chinese" (20) is shown upon the extreme right.

The small size of the hybrid fruits is shown by comparing the eighteen samples with the parents. Some attempts have been made to arrange the several specimens so as to place those most favoring the "American" type at the left hand, and as there is no marked difference to be noted, it is very evident that, so far as the fruits are concerned, they are quite uniformly alike in this set of blend plants. It is not until the next generation of plants is matured that the variations may be expected. Some of the fruits in the engraving were photographed young and while they still held the purple color of the "American" parent. In other words, the small fruits at 9 and 14, in which the calyx still covers a considerable portion of the deeply-corrugated fruit, were decidedly purple, and suggested that these fruits may develop along lines of the purple parent and form fruits of considerable size. The extreme "spininess" of the stems of this hybrid may be noticed at 6 and 9, where the prickles resemble in shape and are in hardness like those of the brambles, making these plants disagreeable indeed to handle. Upon October 23d the final harvest was made, resulting in a total of sixty-seven fruits, the largest being two inches in the longest (equatorial) diameter, and containing but few seeds. The smaller fruits had all passed the purple stage, but showed strong bands of green radiating from the stem end, alternating with the orange that was replacing the purple and green. Many of the smaller fruits were, perhaps, not younger than the larger ones, but were uniformly seedless, to which condition the retarded growth may be due. The excessive spininess of this hybrid is manifest in the fruit stem and calyx, which were so covered with stiff prickles as to make the handling of the specimens a matter of discomfort.

Reciprocal Hybrids of American and Chinese Eggplants.

Seventeen blend plants were grown this season of the "Dwarf Purple" upon the "Scarlet Chinese"—represented in the records by the fraction 6/25. This set of plants was very uniform in size (two and a half feet high), and had purple foliage and stems, agreeing quite closely with the male parent. The bloom appeared the middle of June, and the plants continued to be full of flowers until cut down by the autumn frosts. There were only a few fruits produced, and these were small, much corrugated, and of a light orange color. The "Chinese" parent evidently was strongly prepotent in the fruit qualities, while the "American" seems to be more influential in the vegetative organs, but, upon the other hand, the "spines" of the "Chinese" were somewhat intensified.

A total of seventy-six (76) fruits of this hybrid was gathered upon October 23d, varying from two inches to three-fourths inch in longest diameter. The smaller fruits were all seedless, and the largest had only a few seeds.

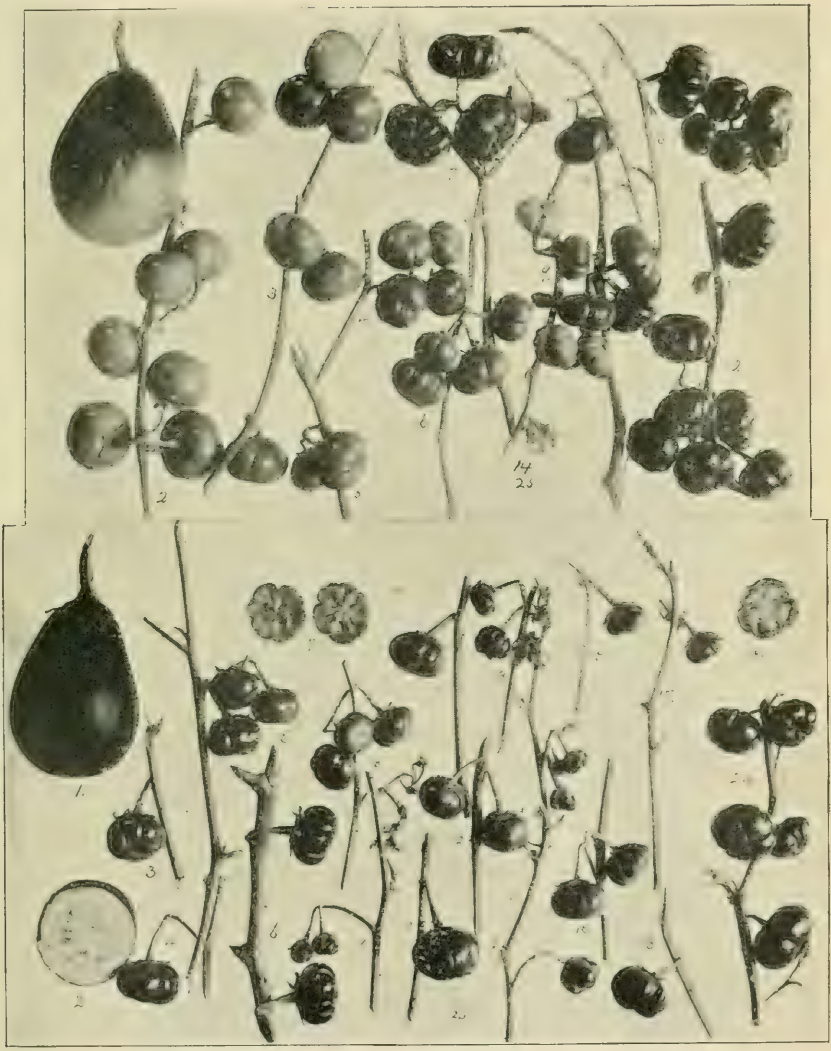

PLATE XI.

Eggplants. The upper half shows a series of stems with fruits of the "American-Chinese" hybrids (second generation). The types of the parents being shown at 1 and 12. In the lower half of the plate are shown samples of the blend of "Pride of Sunnyside" upon the "Scarlet Chinese," the parents being given at 1 and 20.

The reciprocal of the above hybrid was represented by eleven thrifty plants, resulting from the union of the "Scarlet Chinese" upon the "Dwarf Purple," the record fraction here being 25/6, that is, the reverse of the last. The plants were in full bloom upon August 9th, and the record shows that the plants were practically the same as those of 6/25, above described, excepting in the matter of size, they being uniformly over a third larger (four feet). The plants were almost covered with blossoms throughout the season, but were not prolific. A total of one hundred and fourteen fruits was gathered upon October 23d, varying from three-fourths inch to two inches in longest diameter; the latter only contained any seeds.

When the gathered crop of these two blocks of reciprocals was studied side by side a close resemblance was observed in size and form of the fruits, those of 25/6 being more uniform, but had the whole one hundred and ninety specimens been mixed together, it would have been impossible to separate them again into their respective piles. It is noted that the 6/25 produced only four and a half fruits per plant, while its reciprocal, 25/6, yielded an average of ten. In both hybrids there were plants entirely without fruits, and it was further observed that the smaller plants of each set were the most prolific.

Egyptian Eggplants.

Two packets of eggplant seed were received from the United States Department of Agriculture some weeks after the regular time for sowing, but were given a place in the Gardens.

No. 18543. "Black Fruit." This was represented by fourteen plants, which made a good growth for so late in the season, some of the fruits reaching a remarkable size before the frosts came upon October 12th. The plants and their fruit resembled quite closely the "Long Purple," but exceeding it in their vigor and compactness of growth. The fruits were all purple, excepting those of one plant, upon which they were nearly round and striped. (Seed will be saved, but it may be immature.)

No. 18544. "White Fruit." The fifteen plants of this lot were in nearly all respects similar to those of the above number and were inferior to it because the fruits (long and white) had a strong tendency to crack. Some of the plants were alongside of a giant hybrid eggplant and were overshadowed by it.

The above two lots of seeds were obtained by Mr. D. G. Fairchild from Mr. George P. Foaden, of Cairo, Egypt.

GENERAL NOTES UPON EGGPLANTS.

The work of breeding eggplants that has been carried forward for the past few years indicates that the number of well-established varieties is not large, and that several so-called kinds differ from some others little more than in name.

In size of plant, there are the tall kinds, like the "Black Snake" and "Pekin," and the low sorts, as the "Dwarf Purple," between which are grouped into two quite artificial sizes, namely, "medium tall" and the "medium short," the main portion of the popular sorts of to-day.

The color of foliage offers a point of distinction between some varieties, as the "Pekin" and the "New York Improved," but there are many kinds in which there is only a small amount of the purple in the plant, making it intermediate between the two extremes.

In color of fruit there is a character that aids in the separation of varieties, some being white and the larger number dark purple, while a few are pink and others striped.

The form of the fruit is fairly constant in some sorts, as the "Black Snake," with the long, often curved, "eggs," and the "Pekin," having a globular fruit. The oval is met with in several varieties, but the pear shape is more common and is quite typical of the truly dwarf sorts.

The point that has been particularly impressive is that of the added vigor of the blend plants in crosses between varieties of the garden species and the hybrids secured among the American and Chinese species. As has been elsewhere stated, it seems well worth the while for growers of this vegetable to make crosses between distinct types of eggplants for the special purpose of bringing increased vigor and fruitfulness into the offspring. It has not yet been determined how long the renewed strength will last, and therefore it is well to secure fresh combinations every year.

The many reports that have been secured from those who grew eggplants for the first time lead to the opinion that the seedlings are less hardy than tomatoes and other garden plants started indoors, and their failure later on in the garden seems to emphasize the fact that eggplants need high feeding and abundance of moisture and sunshine. In other words, when under the best conditions they thrive almost like tropical vegetation, but in a lean soil, with lack of water, they sicken and barely live as fruitless plants. The plants of the Gardens could, doubtless, have been made more productive by adding food and drink, but one of the objects in the experiment was to study the crosses under possibly only average conditions.

Another method that obtained in the Gardens was entirely against the keeping quality of the fruits produced. The plants were unsprayed and the crop left to mature its seed, or at least so that the fruits might be studied. In this way the blights have been in evidence and some sorts suffered much more than others. All the dwarf sorts, with their small pear-shaped fruits, have shown remarkable resistant power to the decay germs (suggesting lines for future breeding), while the large-fruited sorts of the oval types have rotted worst of all. The long fruits that are held from the ground upon high plants are less apt to decay than the larger fruits borne upon the soil by medium-low plants. Again, the long, widely-scattered foliage of the "Pekin" type of plants lets in the sun to the fruits, and doubtless helps to keep them from decay.

It is not any great stretch of the imagination to conceive of a fruit that, while not differing greatly from the common sorts as to the interior, shall have a skin sufficiently firm and thick to shield the flesh from the microscopic enemies that work their way so quickly into the present type of fruits. A more secure natural cover would be welcomed by the shipper and dealer, and make it possible to have the large and attractive fruits of this vegetable reach the consumer in a more acceptable condition.

EXPERIMENTS WITH LIMA BEANS.

The "Station" and "Kelsey" bush lima beans were grown upon a small area of the Gardens, namely, four plot rows (a total of 128 feet) were planted with the latter, and of the former, selected "flat" seeds were planted in four rows and "plump" seeds in an equal area. Thus there were twelve rows of the "Burp-hends" grown in three blocks of four rows each, side by side.

The "Kelsey" was noticeable for the uniformity of the plants. In the "Station" there was some tendency to twine, especially in the four rows planted with the "plump" seeds. During the wet weather of August the flower-stalks and young pods mildewed somewhat, and were freely sprayed with Bordeaux. Later on the mildew disappeared and the crop was harvested with results given later.

The "Kelsey" is an earlier variety than the "Station," with the plants smaller and approaching the "Henderson" parent—the Sieva type. Its foliage is darker than that of the "Station" and less susceptible to the mildew. When it was harvested upon September 6th the "Station" was still in bloom. There were 118 plants, of which 13 were discarded as being later and less prolific than the others, and 49 of the remaining 105 were selected as superior—from which the crop for next year is to be grown—and 56 as seconds.

Eleven days later, there having been no frosts, the "Station" blocks were harvested, with the following results: Of the 101 plants from the "flat" seeds, 31 were rejected and the remaining 80 were graded as follows: Extras, 10; fine, 12, and seconds, 48. The "plump" lot had 114 plants, of which 64 were rejected, leaving extras, 10; fine, 6, and seconds, 34.

The weights of ripe seeds for each of the three blocks are as follows: "Kelsey," 7½ pounds; "Station" (plump), 5¼; "Station" (flat), 7¼. It is seen that the "Station," with plump seeds and from plants that inclined to be "viney," gave a much smaller yield than the "flat" strain, which in turn was exceeded, although but little, by the "Kelsey."

The upper half of Plate XII. shows samples of the two strains of the "Station" beans. The watch glass upon the left contains the "plump" seeds, and the same kind is shown, placed edgewise,

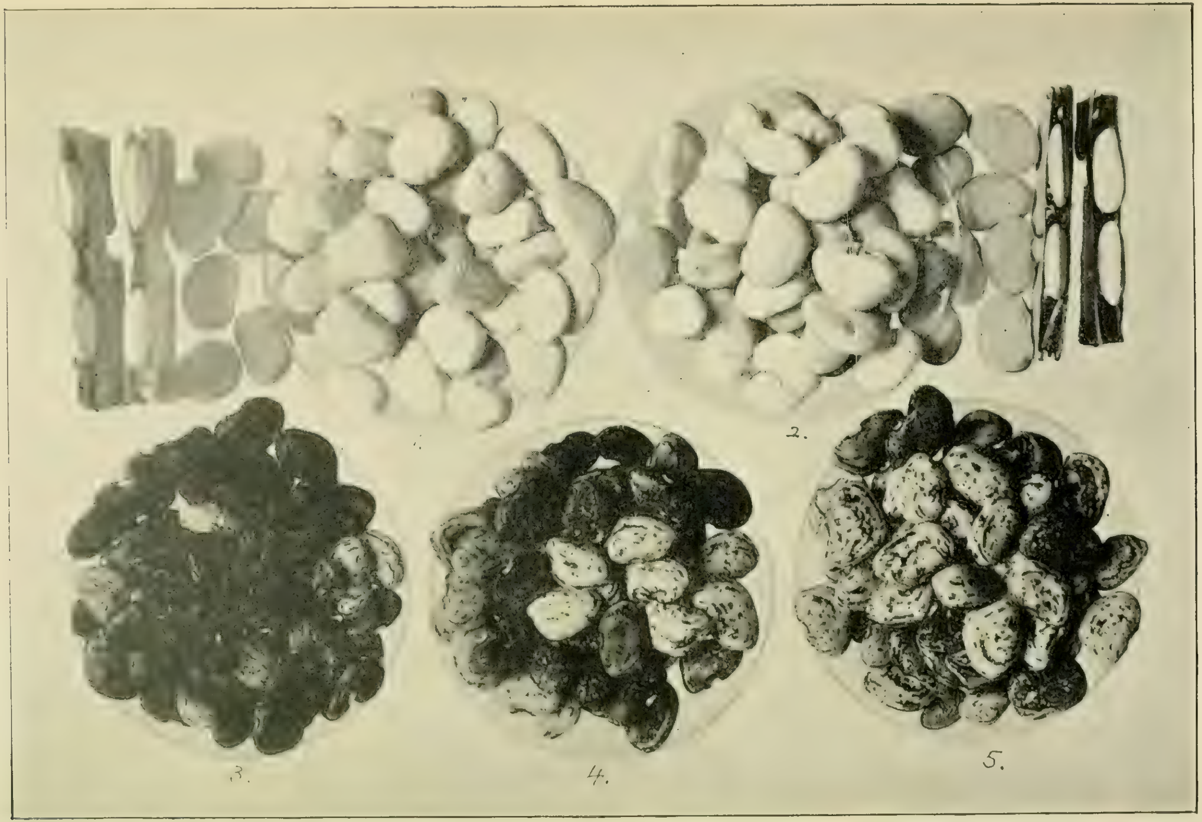

PLATE XII.

Lima Beans. Plump and flat "Station" Bush Limas are shown at 1 and 2, respectively; at 4 is seen the "Jackson Wonder" with samples of the results in selecting for dark seeds at 3 and for light seeds at 5.

still further to the left. In like manner the "flat" strain is shown to the right. The difference is not great, but it may be possible, through several years of isolation, to fix both forms and compare the value of each.

Reports Upon "Station" Bush Lima.

Packets were sent to each of the one hundred and twelve applicants, and below abstracts are given from the reports kindly submitted: " 'Station' bush limas all turned out well; they couldn't have been expected to turn out better." "Limas of good quality for eating; good beans; strong, healthy, fine vines; no blight of any kind." "Think these beans are the best we have ever seen, and most productive; plants large, with medium green leaves." "Strong growers, and made plenty of seed pods." "Vines grew strong and were fairly well set with pods containing from two to four beans, mostly small, flat and pure white, and of good quality." "Fruit of good flavor." "The bush limas have done well, and are a valuable addition to the vegetable garden, being early and profuse bearers." "Was noted as a strong, vigorous grower; produced an abundance of small-podded beans, but pods were well filled; it would prove valuable as a home garden variety; its cooking qualities were good, sweet and tender." "The 'Station' bush limas have been very satisfactory; they have borne unusually well, and the plants are covered with blossoms, so the beans are of good size and run three or four to a pod; the flavor is exceptionally good." "Good size, good taste and good production." "The limas you sent me are very productive and vigorous." "At this date (September 18th) the 'Station' bush limas are still bearing; they are almost equal in size to the pole beans, and are very productive." "Vigorous and very productive; shape like an ordinary lima bean, but smaller; fruit very uniform; about three inches in length." "The limas made a vigorous growth of vine and foliage, and were very profuse bearers; quality good." "The plants grew and yielded well." "Did all right; quite prolific." "Think with careful cultivation would prove a good species." "The 'Station' bush lima is a good, rank grower; dark green foliage, with a fairly good set of fruit; the pods uniform in size." "A very good producer." "The 'Station' bush limas are a good-sized bush; small beans, three in most pods; they have flat pod and white beans; quality good and middling early; as good, and probably better, than any bush lima that I have ever had any experience with." "They are a very fine lima." "Were vigorous and very productive, and of good flavor." "Bean stood about fifteen inches high; very vigorous, producing a small pod, heavily filled with plump beans and very prolific." "Did very well; have noticed that growth is very vigorous, with very few runners, pods containing three or four beans of good size; think it quite valuable." "Very productive, there being from twenty to thirty pods on the vine at a time, three to three and a half inches long, having three and four beans to the pod; in shape and uniformity they were perfect—they were all alike." "Size was small, but vigorous grower and very productive." "The lima beans have grown finely; are still vigorous and bearing as well as any I have ever grown; the fruit is very uniform." "Limas are very productive, vigorous plants, bearing white fruit of excellent quality." "Very good flavor." "Very vigorous and exceedingly productive." "Plant is very vigorous." "Vigorous and healthy; leaves very dark green, very productive; beans small, with three in pod; the quality of the bean much better than 'Burpee's'." "Vigorous plant, about thirty per cent. inclined to climb; exceedingly productive; beans uniform, good size, even shape, good quality." "Very productive, having three small, yet perfect, beans in each pod, which shelled very easily." "Fine quality, pods well filled with medium-sized beans; very productive, excellent for home garden."

Selection Experiment with the "Jackson Wonder" Lima.

The "Jackson Wonder" lima is a bush bean having the plants of medium size with the leaves having dark, small leaflets and the flowers and fruit borne well up from the ground and frequently among or above the foliage. It is, in short, of the "Sieva" type, the most common representative of which in general culture to-day is the "Henderson." It is prolific, and, were it not for the color of the seeds (which are variably marked with dark red or purplish blotches), this might be one of the most desirable of lima beans.

For some years an attempt has been made to reduce the amount of red color in the seeds by selection. In 1904, a block of plants was planted with seeds selected for having the least amount of color, while another lot, showing the largest percentage of red, was planted in a plot a long distance from the former. From the crop secured from each of these plots a second selection, in manner as above stated, was made, and as a result it was stated in the last annual report that "the light seed from the light seeds are nearly as dark as those from the second generation of selected dark seeds." The present year a block of plants has been grown from the lightest seeds that are descendants of the seeds selected for their large percentage of light color, and another from similarly selected dark seeds. A sample of the product for the latter is shown at 3, in Plate XII. A similar sample of the light seeds is shown at 5, while the original unselected "Jackson Wonder" is placed between the selected seeds at 4.

It is seen that selection has removed much of the white in the case of the series of dark seeds, while the opposite is not so evident, namely, the seeds after three years of selection for whiteness are nearly as much colored as the regular stock of the variety.

Crosses of the "Jackson Wonder" Lima.

The "Jackson Wonder" lima has been grown in the Gardens for some years in parallel breeding rows with other varieties in the hope that it would cross in the ordinary course of nature—the working force not being sufficient to carry out the plan by artificial methods. Two rows, six inches apart, one of "Jackson Wonder" and one of the sort to be bred upon, were planted, isolated from all other lima beans, and seed from the row with white seeds was planted in considerable quantity the next season. In this way plants with "marked" seeds were obtained last year (1905) with several kinds of lima beans. From the crop coming from these striped or mottled beans—and frequently they were of a solid purple color—certain of the crosses shown in Plate XIII. have been selected.

Sample seeds of the cross of "Jackson Wonder" upon "Burpee" are shown in the upper rows; ten seeds of the male parent are at the left (1) and the same number of the mother at the right (5), the piles between representing the crosses—three in this instance—each pile in all cases being the full product of a single plant. The seeds at 2 are somewhat larger than the "Jackson" and the color is nearer a dull red than a dark purple as in the male parent, and the seeds of the cross are more nearly alike in their marking than in the "Jackson," in which there is a decided tendency to produce dark seeds, some of which are shown at 1. The seeds at 3 are uniformly of a dark red and not at all striped or mottled and are slightly larger than the "Jackson." At 4 the seeds are not far from those of 3 in color in the picture, but show some differences when a close comparison is made of the two. The plant was less prolific and seems to be somewhat nearer the "Burpee," ten seeds of which make the end pile at 5. The one white-seeded crossed plant did not have seeds ready when the picture was made.

In the next row are shown four crosses of the "Jackson" upon the "Henderson." As the former is the male parent in all the crosses shown in the plate, seeds of it are omitted in all except the first row. Here the seeds are generally not as large as when the "Burpee" blood is present, but it is evident when this row is further compared with the one above it that the "Burpee" has not fulfilled the expectations as to the hoped for increase, the size of the crosses. In other words, the "Jackson," as regards size, has a stronger influence upon the progeny than the "Burpee," and again illustrates the familiar result in breeding that it is easier to hold down than to lift up. Upon the other hand, as regards prolificness, the "Burpee" seems to impress its lack of fruitfulness upon the cross, which is only another instance of the greater downward pull. The two plants, seeds of which are shown at 6 and 7, respectively, were quite alike; in fact, the plants of the whole plot were uniform, as might be expected, for both parents are nearly the same in characteristics outside of the color of the seed. At 8, the seeds are of a handsome dark purple, uniform in all respects and quite different in superior plumpness from the flat and somewhat larger seeds at 4. In this set of crosses there were several white-seeded plants, and the pile at 9 indicates that these "albinos" are decidedly prolific. They are placed in comparison with the "Henderson," the selected seeds of which are shown at 10.

The third row deals with the crosses of the "Jackson" and "Wood's Prolific." The latter has a plant and seed somewhat between the "Burpee" and "Henderson." The seeds shown at 15 indicate this fact, so far as the beans are concerned. The crosses were perhaps a trifle more productive than those with the "Henderson" with the advantage (to many growers) of producing large seeds. The seeds shown at 11 are marked nearly in the same manner as those of the "Jackson." At 12, the seeds are purple with the exception of an indistinct blotching of a lighter red upon the dark background. In the next lot the marking is conspicuous, but, being of two shades of red, it is not shown in the engraving. It is as if the markings in 11 were nearly black and upon a bright red background. Here, again, as in all the crosses except with the "Burpee," there is a fair percentage of white-seeded plants. It is in these "albinos" that the hope lies of getting improved crosses with the "Jackson," the seed-color being objected to by the housewife.

At 16 is shown the seeds of a plant of the "Jackson" upon the "Willow-leaf," the thought here being, among other things, to secure a variety with all the fruitfulness of the "Jackson" combined with the form of foliage in the "Willow-leaf," the latter being more desirable because of its openness, and therefore less subject to the mildew now becoming a dread to the grower of lima beans. The most prolific plant, seed of which is shown in the plate, is represented at 17. The output, while satisfactory, is undesirable from the standpoint of color. There is probably no difference in quality between these and white beans, and the blind would not know that they were dark, but all are not blind, and the white strains will be preferred to the dark ones. At 18, the seeds of a dull-brick red with slight indications of a mottling, characteristic of the "Jackson," are shown. In color, these lie between the dark of 17 and the light of 19, which latter are from a fine productive plant. These white seeds are not quite equal in size to those of the selected ten of the "Willow-leaf" lying nearby at 20.

The lowest row represents seeds of selected plants, among the first generation from the cross of the "Jackson" upon the "Station." The latter is a variety resulting from the union of "Burpee" upon "Henderson," and is a blend of the two in several characteristics. The pile at 21, representing the "Jackson" type, is a set of fine seeds; those at 22 are of the dark purple previously mentioned, while pile 23 is a set of uniformly dull red beans, standing between the dark ones upon the left and the white ones at 24. There is hope that the last-named seeds may, by breeding true to their color, produce a prolific variety of lima of the medium type so far as size and quality of the beans are concerned.

Had there been a white representative in the first series of crosses (upper row in the plate) it might have been possible to have arranged the piles so that, with uniformity, the left-hand piles would represent the "Jackson" seeds, so far as color values are concerned, and have each row end in a white pile, representing the color of the female parent, between which extremes there might have been placed the two intermediates, as has been done in the lower three rows in the present plate.

Further Notes upon the Above Crosses.

"Jackson-Burpee" (91/80).—The plants, though few in number, presented much variation in respect to foliage and fruit, some closely resembling the "Jackson," a few the "Burpee," while others were intermediate. One plant bore an abundance of pods quite as large as the "Burpee," with large flat seeds of a dark red color.

"Jackson-Henderson" (91/89).—This cross was well represented by thirty-seven plants, which were quite uniformly of the "Sieva" type in foliage and pod, and many gave promise of a bearing quality equal to that of the "Jackson."

"Jackson-Wood's Prolific" (91/98).—The forty-one plants, grown by themselves, varied in developing a strong tendency to "run." Thirty-five truly bush plants varied in habit of growth and color of foliage from upright to spreading, with dark green to light green leaves, and one differed remarkably from the rest in its larger, light green leaves, larger pods and spreading habit.

"Jackson-Willow-leaf" (91/97).—Plants were grown from seed selected in both the "Jackson" and "Willow-leaf" rows, and the crosses were divided about evenly in regard to foliage characters. An examination of the seed from twenty different plants, chosen at random—ten of which were "Willow-leaf" and ten "Jackson," upon the maternal side—showed the average size and form to be the same in both cases. One plant of the "Jackson" type was noted as having seed larger than that of either parent.

"Jackson-Station."—This cross, represented by the largest number of individuals (182), showed a plant variation from the

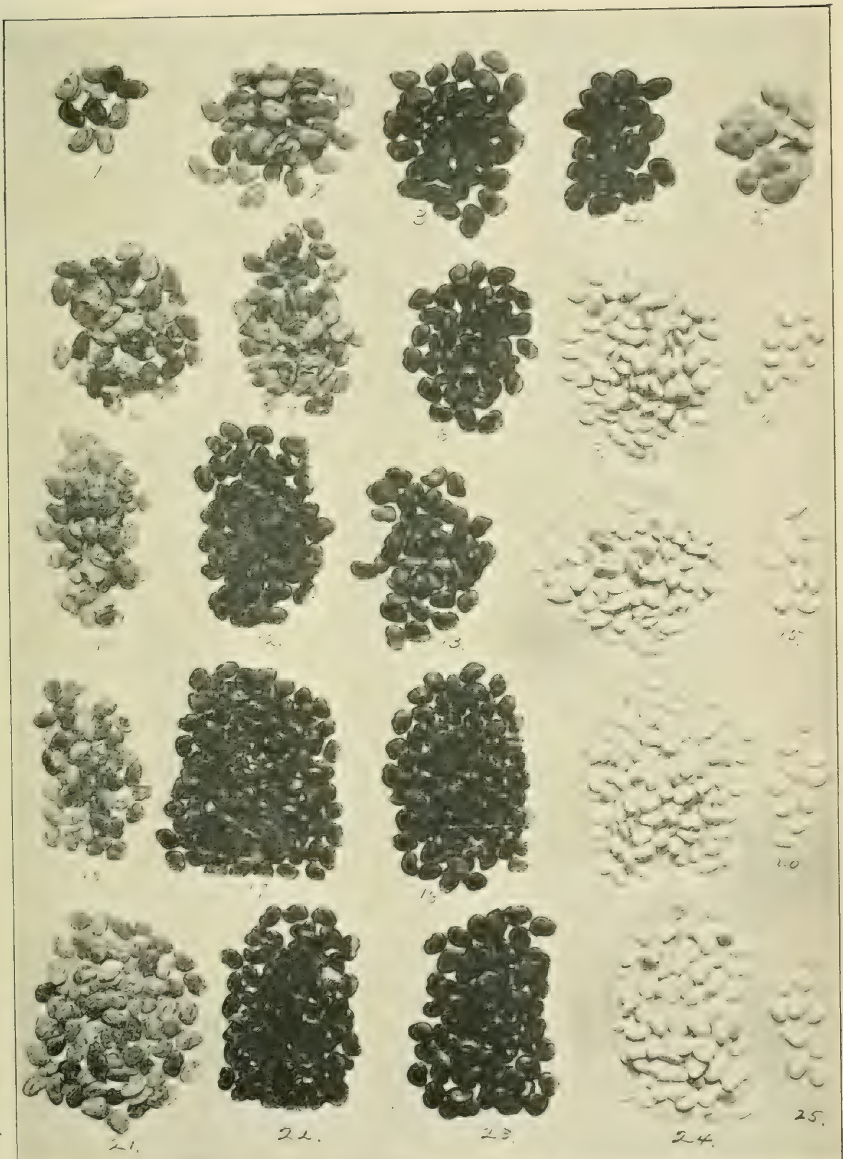
1
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PLATE XIII.

Lima Beans. Crosses of "Jackson Wonder" upon "Burpee," "Henderson," "Wood's Prolific," "Willow-Leaf" and "Station" are shown in the five rows of piles of seeds, respectively.

"Sieva" to the large-leaved type, while one plant developed a strong tendency to "run." At harvest time the bearing quality was found to be excellent, with a variation in pod and seed from that of the "Kelsey" to the "Station."

The following is a grouping of the seed colors for each of the above-named crosses:

	"Jackson" Type.	Dark Red.	Light Red.	Brick Red Mottled.	Light Red Mottled.	White.	Total.
"Jackson-Burpee"	10	4	....	....	....	1	15
"Jackson-Henderson"	21	9	....	....	1	6	37
"Jackson-Wood's"	35	15	....	2	2	22	76
"Jackson-Willow-leaf"	22	10	1	4	3	15	55
"Jackson-Station"	29	13	10	....	8	22	82
Total	117	51	11	6	14	66	265

It is seen that the white-seeded plants make up almost exactly one-fourth of the total and, according to the Mendelian law, the white might well be expected to be dominated by the red color. Should all the mottled ones be grouped together, the total 137 would correspond very closely to the theoretical number (132.5) for the "hybrids," thus leaving the solid red 62, which is quite close to the quarter (66) of white ones.

Notes upon Pole Lima Beans.

Only three pole kinds of lima beans were grown the past season, namely, (1) "Station" (selected pole), (2) "Willow-leaf" and (3) "Speckled Lima."

In 1905 seed was selected from certain of the "Station" plants which showed a strong running tendency. All the plants grown from this lot of seed were true pole beans, thrifty and prolific, with the "Station" type of pod and seed.

Seed was saved from a "Sport" of 1905, which appeared in a standard row of the "Sieva" type. Five hills were planted, most of the plants being true to the parent type, and all others were discarded.

Of the thirteen plants eleven were pole beans and two were dwarfs, five of the former having more vigor than the others and bearing broader foliage than the true "Willow-leaf" form, and larger pods and seeds than the ordinary "Sieva" type.

A few seeds of the "Speckled Lima," received in 1905 late for planting, were grown, and matured a small crop. From this two plants resulted the present season, both resembling the "Burpee" in pod, while the seeds are marked with red.

EXPERIMENTS WITH BUSH BEANS.

The seventy-six crosses, made during 1904 and 1905, were planted April 25th–29th in the new land. When these were nearing maturity a second crop was planted (July 24th–28th) between the old rows, and from this there were ripe seeds before October 18th, the date of the first killing frost. Many of the crosses have advanced to the fourth generation and a few beyond it. Fifty additional crosses were made the past season, some of which have been carried through the blend.

With the ideal snap bean in mind—a medium-sized, round, white-seeded, stringless, prolific, early wax or green pod—three general divisions of the crosses may be made, namely, desirable, uncertain (or doubtful) and the rejected.

Some Promising Crosses of Bush Beans.

"Earliest Green Pod-Bismarck" (14/102).—This cross is interesting, as it combines the green and wax-pod characters. Three hundred and thirty-one plants were grown of the second generation and gave four distinct colors or markings, of which 80 were black, 28 brown, 198 mottled and 25 tricolor. The mottled include the parent type (14), the brown closely resemble the "Six Weeks" type of seed and the "tricolor" is a curious mottle made up of three colors. Seeds of this cross are shown in the upper row of Plate XIV.

"Everbearing-Cylinder" (17/110).—The "Everbearing" is represented by a long, flat, green pod with flat, white seeds. "Cylinder Wax," a round, stringless, black wax pod, is undesirable only in the color of its seed, a defect which may be easily overcome in the cross by selection. The aim is to combine several desirable qualities, and secure a stringless, round-podded, white-seeded wax bean.

"Longfellow-Marrowfat" (26/29).—This cross combines the early, long, round, stringless, green pod of the "Longfellow" with the white seed of the "Marrowfat." By selection, it seems possible to secure a long, round, white-seeded, green pod, qualities which no commercial variety in the Gardens has been found to possess in full. Seeds of this cross are shown in the second row of Plate XIV.

"Longfellow-Brittle" (26/101).—This cross, together with its reciprocal, 101/26, promises either a round, stringless, green pod with the "Longfellow" type of seed, or a round wax pod with the "Brittle" kind of seed, and either may make a desirable new variety. Plants of this cross are prolific and early and a wax with the pods borne above the foliage like the "Longfellow" would be superior to the mother.

"Brittle-Yosemite" (101/146).—This combines the excellent qualities of the "Burpee Wax" with the remarkably large, fleshy pod of the "Yosemite." By rejecting the black-seeded plants, there is promise of a mammoth "Burpee" type superior to the "Yosemite" in prolificness.

"Bismarck-Detroit" (102/113).—This cross, which has been carried to the sixth generation, was shown in the annual report for last year, Plate VIII., which represented seed from sixteen different plants, all grown from a mottled seed of a plant of the second generation. Of these, two were black-seeded, five with the dark "eye" of the "Detroit" and nine were mottled. The "dark eye" seeds have bred true up to the fifth generation. One of these has a long, flat, straight wax pod with a seed like "Bismarck" in form and giving a superior golden wax bean.

"Davis-Black" (11/107).—This is a combination of the long-podded, white-seeded "Davis Wax," and a medium length, round-podded "Black Wax," and is promising.

"Davis-Refugee" (111/133).—This cross unites the fine qualities of the "Keeney Refugee" with the longer, white-seeded pod of the "Davis." The object sought here is a white-seeded "Refugee."

"Scimitar-Davis" (129/111).—Both parents are prolific bearers of large pods, the "Scimitar" being a round, curved, black-seeded wax. Out of this combination it is hoped to obtain a white-seeded "Scimitar Wax."

"Golden Eye-Boston Snap" (130/3).—Although neither parent is round-podded nor stringless, both are early and prolific. "Golden Eye" is a fine, flat-podded wax and "Boston" has white seeds. A combination of the two has resulted in a medium-sized wax pod and the seeds are, by selection, uniformly white.

"Jones' Stringless-Golden Eye" (131/130)—Both the parents of this cross are early, prolific varieties with pods of medium size. This union of a yellow-"eyed" variety with one with white seeds has resulted in a curious and unexpected type of seed, namely, one with a dark mottle, excepting at one end, which is white, and which by selection seems to be quite constant. The third row in Plate XIV. shows several groups of seeds of this cross.

"Crystal-Brittle" (145/101).—The "Crystal Wax" is a medium-sized, late plant with peculiar light, silver-green, round, curved pods with small white seeds. It is a variety of high quality, but the pods are too small. The "Brittle Wax" is one of the best varieties of its kind, being early, prolific and with round, stringless pod of good size but lacking the pure white seed. By a combination of the above qualities, and selecting white-seeded plants, a new variety superior to either parent is looked for. Forty-four plants of the first generation were grown, the color record being as follows: White, 10; black, 21; mottled, 10; brown, 3. Certain plants bore fine specimens of "Crystal Wax" pods larger than the parent, other plants produced a fine white wax, while many were green pods. Present indications are that this is one of the most promising of all the crosses. The blend plant of this cross, although both parents bear white flowers, produced purple blooms, and the seeds were but slightly mottled, being nearly a solid black when dry. Seeds of this cross are shown in the lower row of Plate XIV.

"Crystal-Davis" (145/112).—Both parents are choice white-seeded wax varieties. The blend produced green pods with white seeds, which gave in the next generation a fine, round, white wax pod, medium in size. No colored flowers or seeds have appeared in any generation.

Further Notes Upon Seeds of the Above-Named Bean Crosses.

From among the above list of crosses of the bush beans four groups are selected for a combination group in Plate XIV. The first pile of each row represents the male parent of the crosses in its respective row, while the last pile is correspondingly the female. Thus, in the first row, the beans at 1 are of the "Earliest Green Pod" (No. 14 of the recorded list), while the variety crossed upon is represented at 7, namely, the "Bismarck Wax" (102). All of the crosses shown between the piles 1 and 7 are represented by the fraction 14/102, which, as before explained, indicates that the green-podded sort was used as the male, while the wax variety bore the seeds obtained by the artificial pollination.

The "Earliest Green Pod" is a variety with a large, medium early plant, bearing pink flowers, followed by long, flat pods containing medium-sized light brown seeds with curved bands and blotches of pink. The "Bismarck" is an early, medium-sized variety with purple flowers, long, flat wax pods that mature black, plump seeds, below medium size. The ten seeds of each sort at the ends of the upper row in the plate give relative sizes and something of the color characteristics of the two varieties.

The seeds of the crosses are arranged somewhat according to the apparent resemblance to the parents, and therefore at 2 the beans approach the form and markings of the male parent (1), but they are much lighter and longer and more attractive to the eye. At 3 the seeds are without markings excepting a distinct brown eye, while the body of the seed is colored an olive tan not altogether pleasing to the eye and not met with in any of the commercial sorts in the collection.

The seeds of 4 are coarsely mottled with nearly a seal brown upon a lighter background, giving a bean that photographs nearly black, but is a mixture of two closely-related browns, and producing a strange-looking seed that in itself is unattractive. Quite in contrast with the last is the lot at 5, where the amount and disposition of the markings are practically the same as in 4, but the contrasts are strong between the two colors, namely, a dark purple upon light gray, thus producing an attractive bean. The seeds at 6 are practically black, as much so as the "Bismarck," near which they are placed in the plate. The two, however, are quickly distinguished by the shape, it being very flat in the cross, and therefore the seed appears much the larger of the two in the picture.

The second row deals with the "Longfellow" (26) and "White Marrowfat" (29), both green-podded sorts and differing from each other markedly in the color of the flowers, shape of pods and color of seeds, the "Longfellow" having pink blooms, round pods, and long, mottled (dull red and gray) seeds, while the "Marrowfat" is with white flowers, flat pods, and large, short, plump white seeds. The sample plant, selected as nearest to the male parent, has its seeds, in part, shown at 9. They differ somewhat in the markings, or, more accurately, in the greater difference in the colors between the darker portions and the background, thus giving a more attractive lot of seed. They are also somewhat shorter and broader than the "Longfellow." The next lot (10) differs chiefly from the last in the much lighter color of the markings. Both are much blotched like the male parent, and differ from it in being less slender. At 11 the seeds are white, like the "Marrowfat," but have the shape of the "Longfellow," and taking the two named qualities into consideration, this lot merits a midway place in the row. The next lot (12) is a step nearer the "Marrowfat," and the ones at 13 are not easily distinguished from it. The gradations in shape are much more easily worked out than those of color, for the plate shows that three lots are dark and four light, with but little intergrading—a little less, however, than in reality.

The third row has points of special interest because the two parents pass for white beans, the male parent, "Jones' Stringless" (131), being entirely so, and the mother of the crosses is white, with a dull yellow eye, giving the name "Golden Eye" (130) to this variety. The plants of both sorts are medium-sized, white-flowered, with the "Jones" having a medium, round pod and the "Golden Eye" a short, flat one, the latter having the larger seed. At 16 is shown a pile of white seeds that agree quite closely with the parent shown upon its left (15). The seeds shown at 17 are a plain tan, and therefore somewhat darker than the color of the "eye" in the female parent. The seeds at 18 are unlike any other in the series in being mottled on nearly the whole surface with two shades of brown, the exception being a white tip at the root end of the bean. The same white extremity is still more conspicuous in the next lot (19) because the uncolored area is larger and the main

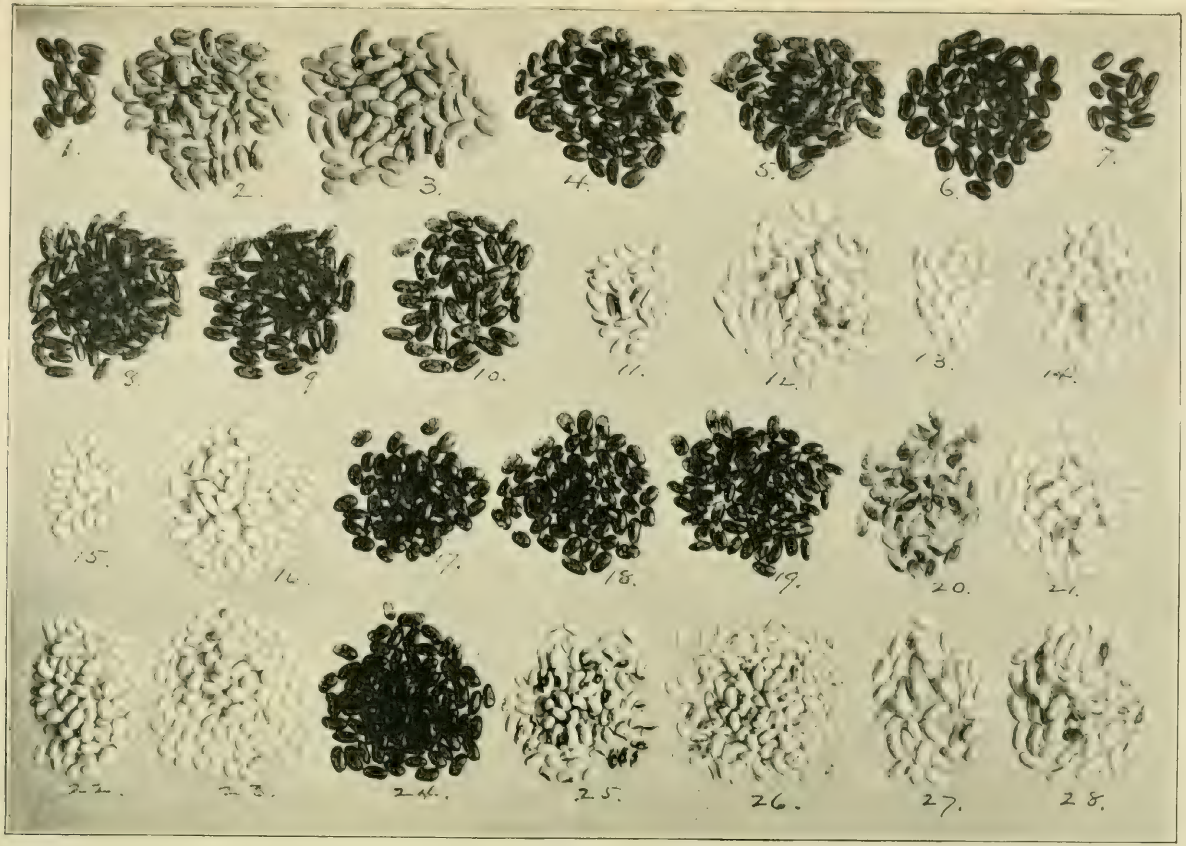
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PLATE XIV.

Snap Beans. The first row shows the "Earliest Green-Pod Bismarck" crosses; the second, "Longfellow-White Marrowfat;" the third, "Jones' Stringless-Golden Eye" and the fourth row, "Crystal Wax-Brittle Wax" crosses are given.

portion of the seed is a plain black. This peculiar disposition of color is to be made out by a close inspection of the engraving, but, in reality, it is very evident, giving the seeds a striking characteristic. At 20 the seeds are quite suggestive of the female parent (21) because the light tan color, confined to the "eye" in the latter, is here spread over nearly one-half of the seed, as is quite plainly shown in the engraving.

In the fourth row the two parents are "Crystal Wax" (145) and "Brittle Wax" (101), the former being the male, and is a variety with a small plant and white flowers, producing short, round, curved pods, thick in flesh and bearing very small, oval, white seeds late in the season. The "Brittle Wax" is a medium-sized plant, fairly early in bearing, with white flowers, long, round pods, and medium large, long, often curved, seeds with a dark "eye."

Points of contrast are many between these two varieties, not the least being the color of the pods which is a pea-green in the "Crystal," due to the chlerophyll being located largely in a layer at a distance from the surface of the pod, while the "Brittle" is of the true wax type.

At 23 is shown the seeds of the third generation of a white-seeded strain of the cross. It is much more productive and somewhat earlier than the "Crystal," and the seeds, a decided oval, are somewhat larger than the latter. The seeds at 24 appear nearly black but are a dark, mottled brown and quite near in this respect to the blend obtained from the original cross. At 25 is shown a set of seeds in its second generation which are remarkably long and curved, medium between the two parents in size and with a dark "eye" that considerably exceeds the "Brittle." The seeds at 26 are still smaller and decidedly curved, with a dark color at the "eye" that is usually only a portion of a circle. This shape of seed seems to be correlated with a round, plump pod much sought for. The seeds at 27 are pure white and of a shape that agrees quite closely with the "Brittle" (28) near which they are placed.

A study of the combinations of characteristics that do not pertain to the seeds shows some points of interest in the breeding of these plants.

Less Desirable Crosses of Bush Beans.

"Canadian Wonder-Golden Eye Wax" (8/130).—The male parent is a large, stocky, thrifty plant with long, flat, green pods containing large, flat seeds. The "Golden Eye" is an early, hardy, prolific wax with flat pods of a medium size. A combination of the two has resulted in an early, prolific plant bearing a large, flat wax pod having seeds with a pink "eye," and no wax variety yet grown at the Gardens has this type of seed.

"Dwarf Chocolate-Burpee's Brittle Wax" (11/101).—The union of the "Dwarf Chocolate," with its slender green pods, with the "Brittle," having round, curved wax pods, has resulted in plants bearing two distinct types of fruit, namely, a slender, curved green pod with "Burpee Brittle" type of seed, and second, a long, round, curved, slender wax pod with either parent type of seed as desired.

"Dwarf Chocolate-Flageolet" (11/114).—The "Flageolet Wax" is a large, broad, flat pod which, by the infusion of "Dwarf Chocolate" blood, has become much more slender while retaining its golden color and prolificness. A plant bearing slender wax pods with chocolate-çolored seeds may be obtained by this cross.

"Lightning-Eclair" (25/13).—The "Lightning" has mottled flowers and is extremely early. As a snap bean it is undesirable, but, in the combination above, the slender pod of the "Eclair" is retained with the earliness of the "Lightning." Selection is being made to obtain a plant with striped flowers bearing "Eclair" pods with "Lightning" seeds which are of a peculiar mottled gray color.

"Lightning-Marrowfat" (25/28).—This combination has resulted in a very early, white-seeded cross, which, if not desirable as a snap bean, promises to be a good "shell' variety especially where the season is short. Plants grown from the first crop, harvested the last of July, matured seed fifty-four days from the time of planting.

"Lightning-Prolific Tree" (25/34).—This cross is similar to the one preceding but has a smaller white seed. It also gives promise of being an early "shell" bean.

"Lightning-Davis' Wax" (25/111).—Selection from this cross has resulted in two types, (1) an early plant bearing long green pods with large, white seeds, and (2) a kind having a long, flat

wax pod with the same seed color. Both are inferior to "Davis" as a snap bean, but they may become good new "shell" varieties.

"*Longfellow-Cylinder Wax*" (26/110).—This is a combination of two good varieties and has produced as one type the "Cylinder" pod with the "Longfellow" seed.

"*Low's Champion-Golden Wax*" (27/122).—A union of these two varieties has developed a "Golden Wax" pod with the round, red seed of "Low's Champion" pointing to a red-seeded "Golden Wax."

"*White Marrowfat-Canadian Wonder*" (29/8).—Both varieties represent late plants with large pods and seeds, and, as the "Marrowfat" has a white seed, this means that by selection of the white-seeded plants a new "shell" variety resembling the "White Kidney" (182) may be obtained.

"*Henderson's Black Valentine-Detroit Wax*" (45/113).—By uniting the good qualities of the "Henderson," a long, round, stringless pod, with the golden color and earliness of the "Detroit," plants bearing a superior golden wax have been secured. Plants have also resulted, promising the "Black Valentine" pod with the "Detroit" dark "eye" seed.

"*Stringless Valentine-White Marrowfat*" (46/29).—The outcome of this cross is an upright, sturdy plant bearing an abundance of short, straight, round pods. The selection of white-seeded plants means a combination of string and shell bean with a plant superior to the "Marrowfat" in two respects, namely, earliness and true dwarf habit.

"*Green Winter-White Marrowfat*" (51/28).—Both these varieties have white seeds and their combination results in a plant earlier and more bushy than the "Marrowfat" with short, plump pods. This cross promises another "shell" variety.

"*Burpee's Brittle Wax-Wonder of France*" (101/52).—Here the white seed of the "Wonder" is combined with the good traits of the "Burpee" producing another white-seeded wax bean.

"*Detroit Wax-Black Wax*" (113/107).—The "Black Wax" has a round pod and this union resulted in a round-podded "Golden Wax," and, by selection, the "Detroit Wax" type of seed is assured.

"*Flageolet-Detroit*" (114/113).—From this combination plants have resulted with the large, flat pod of the "Flageolet," containing large, flat seeds with a red "eye" similar to the "Detroit."

"Flageolet-Golden Eye Wax" (114/130).—Results from this cross are similar to the one above, producing a large, yellow-"eyed" instead of a red seed. If the smaller pod of the "Golden Eye" is preferred, by the selection of red-seeded plants, a new "Wax" with the red seed can be obtained.

"Flageolet-Saddleback Wax" (114/141).—The "Saddleback" is a good, round pod, and, in combining it with the "Flageolet," a red-seeded "Saddleback" may be obtained.

"Golden Eye-Dwarf Chocolate" (130/11).—The selected plants of this cross bear long, slender wax pods, containing a long, yellow-"eyed" seed; this may be an improvement upon the "Golden Wax" in size and shape of pod.

"Keeney's Refugee-Burpee's Brittle Wax" (133/101).—Both varieties possess the good traits of prolificness with a round, curved, stringless pod, but the "Keeney," with its characteristic narrow-leaved foliage, is later than the "Burpee" and has a mottled seed. One of the objects sought in this combination is a plant with "Keeney" foliage and a "Burpee" seed.

"New Profusion-Wardwell's Kidney" (137/144).—"New Profusion" possesses the "Keeney's Refugee" characters of plant, pod and seed, while "Wardwell" represents a plant bearing long, flat pods with a dark-"eyed" seed. The object of this cross is a variety with "Refugee" type of plant and pod and seed marked like the "Wardwell."

"Crystal Wax-Dwarf Chocolate" (145/11).—Uniting the peculiar pod color and white seed of the male parent with the long, slender pod of the "Dwarf Chocolate," an improved "Crystal Wax" is hoped for.

"Crystal Wax-Bismarck Wax" (145/102).—This is another combination with the "Crystal Wax," and, by selection of plants bearing longer pods with white seeds, an improvement may be secured.

"Crystal Wax-Flageolet" (145/114).—This cross does not produce a round pod, as hoped, but a prolific sort of the "Crystal Wax" type, with a large pod and small white seed, is anticipated.

"Crystal Wax-Yosemite" (145/146).—By selection of plants resulting from this union a mammoth-podded "Crystal Wax" is sought, and, by selection, plants with wax pods, a white-seeded "Yosemite" mammoth is expected.

"Livingston's Pencil Pod-Eclair" (148/13).—The "Pencil Pod" is of the "Refugee" type of foliage, with longer pods, which, combined with the long, green, flat pod of the "Eclair," has resulted, by selection, in a long, green, curved, round pod, with either brown or mottled seeds. This promises a fine, new green pod variety.

Rejected Crosses of Bush Beans.

The following crosses are rejected because, from the economic point of view, they seem to promise nothing superior to the parents involved. In other respects they offer quite as much of interest as do those of the "Promising" groups:

"Bountiful Bush-Lightning" (2/25). Earliness was the main thought in effecting this cross, twenty-two first and ninety-seven second generation plants being grown. Many of the plants were the first in the field to bloom and the dark-green foliage of the "Lightning" was evident, as also its long, green, flat pods. The dominant seed colors were brown and dark mottled.

"Byer's Bush-Longfellow" (6/26). By uniting these two excellent green-podded varieties it was hoped to secure something better than either. Both parents are early and prolific, with round pods, the "Longfellow" being much the longer.

"China Red Eye-Best of All" (9/1). With this combination, the object was to secure a new variety with a red-"eyed" seed. Thirty-four plants of the first and twenty-four of the second generation were grown, the "red eye" becoming a fixed character in the offspring of two plants, but no advance was made in earliness, type of pod or bearing quality.

"Crystal Wax-Henderson's Black Valentine" (10/45). The cross plants, one hundred and nine in number, were late, wide-spreading and bore small pods.

"Dwarf Chocolate-Mammoth Stringless" (11/40). Considering the dark-green, narrow-leaved foliage and long, slender pod of the "Chocolate," and the round, stringless pod of "Mammoth," their union pointed to a prolific offspring, with "Chocolate" type of foliage and a long, slender, round, stringless pod. Twenty-three plants, all of the first generation, were grown, the plant characters of "Mammoth" dominating, but the desired long, slender, round pod failed to appear.

"Dwarf Chocolate-Six Weeks" (11/55). Of the seventeen first-generation plants grown, none was earlier, more prolific or longer-podded than "Six Weeks."

"Lightning-Burlingame Medium" (25/5). This cross was represented in the field by twenty-five first and fourteen second generation plants. The prepotency of "Lightning" was shown in the offspring, resulting in early plants with dark-green foliage, but they were not prolific and bore flat, stringy pods.

"Lightning-Longfellow" (25/26). As in the cross above (also the two following), the male parent dominates. Of the seventy-two plants grown in the field, forty-one were of the first and thirty-one of the second generation. A "Longfellow" plant and pod with seed of "Lightning" was sought, but no plants developed full, round pods, so desirable in the "Longfellow."

"Lightning-Wonder of France" (25/52). This combination offered an earlier white-seeded, green pod. Forty-eight plants were grown during the past season, nineteen of the first generation and twenty-nine of the second. While the plants were early, the pod was inferior to that of "Wonder," and the thin, flat, white seed of selected plants did not promise a good "shell" bean.

"Lightning-Six Weeks" (25/55). Both parents are early and the mother has a long, flat pod. Of the forty-nine plants grown, none equaled "Six Weeks" in pod quality.

"Lightning-Black Wax" (25/105). A wax variety with "Lightning" type of seed was expected in this cross. Fifteen plants of the first and fourteen of the second generation were under observation. Many bore broad, wax pods and were quite prolific, but they were found inferior to the "Black Wax" in quality. This cross is a good one for the study of heredity.

"Low's Champion-Longfellow" (27/26). The union of an early, good bearer with a short, flat-podded sort failed to produce any plants earlier or more prolific than "Longfellow."

"Refugee Green-Six Weeks" (36/52). The "Refugee Green," in itself, is a prolific plant, bearing round, stringless pods. Its union with "Six Weeks" could add nothing more than earliness. Ninety-four plants were under observation—thirty-one of the first, sixty-three of the second generation. Many plants possessed earliness; otherwise, no advance on the parents was made.

"Early Mohawk-Silver Bush" (31/38). This cross was well represented by thirty-five plants of the second generation and one hundred and ninety-three of the third generation. None of the offspring have borne white seeds and the pods are small, flat and stringy. The tendency to "run" was strong in the crossed plants.

"Six Weeks-Henderson's Black Valentine" (55/45). This is another case of combining two good varieties with no advantage gained in the offspring. An especially large number of plants represented this cross in the field—fifty-three of the first generation and four hundred and twenty-six of the second.

"Burpee's Brittle Wax-Lightning" (101/25). This cross offered a "Brittle Wax" pod with "Lightning" seed, but of the ninety-three plants grown, early and prolific as many were, their broad, flat pods were objectionable.

"Bismarck-Brittle Wax" (102/101). This combination represents a cross between a good "Black Wax" and one of the best round pod wax sorts. Thirty-five plants of the first generation and thirteen of the second were grown. Many round pods appeared in the first generation, but the flat pod of "Bismarck" prevailed in the second. Four green-podded plants were discarded. Many plants, though well-podded, did not excel the "Brittle Wax."

"Davis' Wax-Wonder of France" (111/52). This cross, between two long, flat-podded plants, one a white-seeded wax, the other a white-seeded green pod, has promised more from the standpoint of heredity than that of a new variety. A wax pod more slender than 111 was the only advantage apparent, an object already sought after in the promising cross of 11/101.

"Davis-Eldorado Wax" (112/152). This is a cross between two flat-podded varieties, both prolific and early. Eighteen plants of the first generation were grown and twenty-three of the second. The offspring bore long, flat, straight pods, not superior to either parent.

"Golden Crown-Flageolet" (125/114). The male parent is a round, wax pod, but the commercial sort often produces a flat, green pod. This may explain the appearance of large, green, flat pods in the cross. Thirty plants of the first generation were under observation and sixty-one of the second. The plants are rank growers, do not pod well and many "run." White-seeded plants have been selected and have bred true, but the type is not a good one. The pods are large, flat, broad and coarse.

"Golden Crown-Lightning" (130/25). All the plants of this cross have the open, spreading growth of "Lightning," and, while early, are poor bearers with flat, stringy pods.

Novelties in Bush Beans.

Several commercial varieties of bush beans have been grown this season that are not in previous lists. Some of them are practically duplicates of former varieties, but each has a record number assigned to it.

Pods of the following varieties, as they reached full size, were gathered (July 20th) for museum specimens:

158. *"Silver Refugee."* (Notes omitted for this variety last year are here added.) The plants are thrifty and in their foliage resemble "Refugee, Green" (36), with flowers purple, late bearing and prolific. The pods are long, slightly curved, round and like the "Crystal Wax" in color. A table test determined that this bean is of superior quality. It is being bred with the white-seeded varieties.

161. *"Everbearing Wax."* This is a good, prolific "Black Wax" variety, with round pods and medium early.

162. *"California Pea"* (Green). The plants are of upright, open growth, with dark-green foliage and late pink flowers, short and plump pods, like "Low's Champion" (27), and seeds round and yellow, an unusual color in beans.

163. *"Eureka"* (Green). Similar to 162 in plant, flower, pod and seed.

164. *"Improved Black Wax."* The plants are large, thrifty, with purple flowers and early pods, like the "Black Wax."

165. *"Perfection Wax."* This is similar to 164. A promising, early variety, with purple flowers and black seeds.

166. *"Leopard Wax."* A distinct type of plant, tall, with dark-green, broad, rough leaves; flowers pink, pods broad, thick and medium in length, and seeds curiously marked with black spots.

167. "*Mohawk Wax.*" The plants are large and thrifty, with enormous, broad, rough leaves; flowers pink, early; pods long, round, stringless, curved, and seed mottled.

168. "*Golden Refugee.*" The plants are of medium height and bushy, with foliage of the "Refugee" type, but smoother and of a more open growth. The late, prolific pods are between a green and a wax in color, long, round, curved, striped.

169. "*Keeney's Refugee.*" This is similar to 132 and 133 in plant, pod and seed.

170. "*King of the Wax.*" The plants are large, like the "Wardwell" (144); flowers pink, medium early; pods long, flat, curved, stringy; seed resembles the "Flageolet" (114).

171. "*Epicure Wax.*" This is a fine "Refugee" type of plant, with round wax pods; late, prolific; seed mottled. A table test found it to be of excellent flavor, tender and stringless. Its one defect is discoloration from the dark seed.

172. "*Prolific Everbearing.*" The plant resembles "Burpee's Brittle Wax," with flowers white; pods are early, long, round, straight, and seeds are white. Superior to the "Davis' Wax" (112).

173. "*New California Dwarf.*" This is another "Black Wax" type with purple flowers, and pods early, of medium length, rounding, curved.

174. "*Hardy Wax.*" This is a "Wardwell" type of plant, with flowers pink; early pods, of medium length, round, curved, stringless; seeds brown, mottled.

175. "*Lima Wax.*" The foliage resembles that of a lima; plant of medium height and compact growth, with white flowers; pods late, broad, flat, straight; seed white. A table test found this variety excellent in quality, with no discoloration.

176. "*Full Measure.*" This is a large, upright plant, resembling the "Wardwell Kidney" (144), with pink flowers; pods early, long, round, curved, stringless and green; seed mottled, brown.

177. "*Improved Tree.*" The same as "Prolific Tree" (34); flowers white.

178. "*English Stringless.*" The plants are large, with broad leaves, with pink flowers and a long, early, round, curved, stringless wax pod; seed brown, with dark eye.

179. "*French Stringless.*" This is a promising variety, which, like the "Longfellow" (26), bears its pink flowers and early pods above the foliage; pods long, round, slender, curved, green; seed mottled.

180. "*Triumph of the Frames.*" These are low, bushy plants, with small dark-green leaves and white flowers; pods very early, long, flat, curved, green, prolific; seed is white. This variety resembles "Wonder of France" (52).

181. "*Giant Forcer.*" This is another variety of the "Wardwell" type of plant, with pink flowers and medium-early, large, flat, long, curved, green, stringy pods; seed nearly white, with slight markings.

182. "*White Kidney*" (Green). The plants resemble the "Canadian Wonder" (8) and bear white flowers, and these are followed by long, flat, straight, green, late pods. Not a snap bean, but good when shelled.

183. "*Red Kidney*" (Green). The plants are similar to 182, but smaller and with pink flowers. As compared with "Canadian Wonder," it is earlier, with seed of a lighter red. Pods long, flat, curved, late.

184. "*Valentine Wax.*" The plants are small, with dark-green foliage, pink flowers; pods of medium length, round, curved, stringless; very early and promising; seed a mottled pink.

185. "*Hodson Wax.*" Plants of medium height and bushy, with narrow, dark-green, rough leaves, pink flowers; pods long, flat, curved, late; seed a mottled pink.

186. "*Giant Stringless*" (Green). Appears to be the same as the old "Giant Stringless" (46), with pink flowers and long, round, curved, early pods; seed light brown.

187. "*Black Marrowfat.*" These are low-growing plants with dark green leaves, purple flowers and long, flat, curved, stringy, late pods, not desirable for a snap bean; seed black.

188. "*Dutch Runner.*" This is a pole bean with large, flat, white pods, forming late and bearing white seed.

189. *"Broad Windsor."* This variety is often called "English Bean." In foliage and bloom it resembles somewhat the garden pea. The plants are tall and free-blooming, but set little fruit, due possibly to climatic conditions. The pods are short and round, with a husk like a pea when green and turns black at maturity.

190. *"Steckler's New Green Pod."* Large, bushy plants, with pink flowers; pods medium early, long, round, curved and stringless; seed mottled pink.

191. *"Pride of Newton."* This is an early green-podded variety, with sturdy, large-leaved plants and pink flowers; pods early, long, round, curved, stringless; seed light brown with a dark "eye."

192. This is not a commercial variety. It resembles very closely the "Prolific Tree' (34), but is earlier and more productive. These qualities may give it value in breeding.

193. *"Brown Bunch."* This is a late variety of spreading habit, white flowers; pods of medium length, flat, curved, dark green and borne in pairs.

194. *"Burpee's Stringless Green Pod."* The plants are large and of open growth, with pink flowers; pods early, round, curved, and seed is brown.

195. *"Hodson Green Pod."* The plants are striking in size and thriftiness, with large and narrow leaves and pink flowers; pods late, long, flat, curved; seed mottled.

196. *"Jones' Stringless Green Pod."* The plants vary in size from medium to large, with white flowers; pods of medium earliness and length, flat, curved; seeds white.

197. *"Pencil Pod Wax."* The thrifty plants are of open growth, with light purple flowers and medium-early, long, curved, round pod; seeds black. The "Livingston Pencil Pod" (148) has dark mottled seeds.

198. *"Boston Snap."* The name is the same as that of No. 3, but the plants have a more open growth and the flowers are pink, instead of white, and earlier in coming into bearing. The seeds are medium-sized and brown, while those of No. 3 are small and white.

199. *"Yellow Cranberry"* (Green). The plants are of medium size, bushy, with broad leaves and pink flowers; pods early, long, oval; seeds light brown.

Notes, with Engravings, of "Crystal Wax" Crosses.

The "Crystal Wax," with its attractive, pale silvery-green, fleshy pods, produced in profusion, and, bearing small white seed, promises to be one of the best varieties for breeding purposes. Of its seven combinations grown the past season, all except one gave a green pod in the blend; this is sufficient reason to consider the "Crystal Wax" a green-podded variety, at least as to its breeding characters. Five of the above crosses in their second generation show three types of pods, namely, green, "Crystal" and wax.

The blend of "Crystal-Bismarck" (145/102) produced pods strongly marked with purple, a character which was very prominent in the plants of the first generation grown in the greenhouse, and also seen in some plants of the second generation in the field.

The "Crystal-Chocolate" (145/11) cross had the green pod in the second generation, and selection for the "Crystal Wax" type is being made.

In the "Crystal-Burpee" (145/101) and "Crystal-Davis" (145/112) crosses a fine white wax pod is produced that may prove desirable to propagate. Plate XV. represents three plants of the "Burpee" cross, taken July 9th in the field row, when the pods were at a marketable stage. The plant to the left has the white wax type of pod with the form of 101. The middle plant, in foliage and color of pod, is quite close to the "Crystal Wax," while the plant to the right is green-podded and combines the forms of both parents.

"Crystal-Black Valentine" (145/45). The blend of this cross, grown in 1905, was a fine thrifty plant with an abundance of long, round wax pods. The seed was black instead of the usual mottled type, resulting from the union of plants with black and white seeds. A second crop of nine plants was grown the same season, some producing wax pods similar to those of the blend, others green pods resembling those of the "Black Valentine," but neither the "Crystal Wax" type of pod nor white seeds made their appearance. In the second generation, which was represented the past season by three hundred and thirty-nine plants, the same characters of the immediate parents prevailed without exception.

Plate XVI. shows a wax-podded plant in the center, and one with green pods upon the right, and another upon the left, as they stood in the field July 9th.

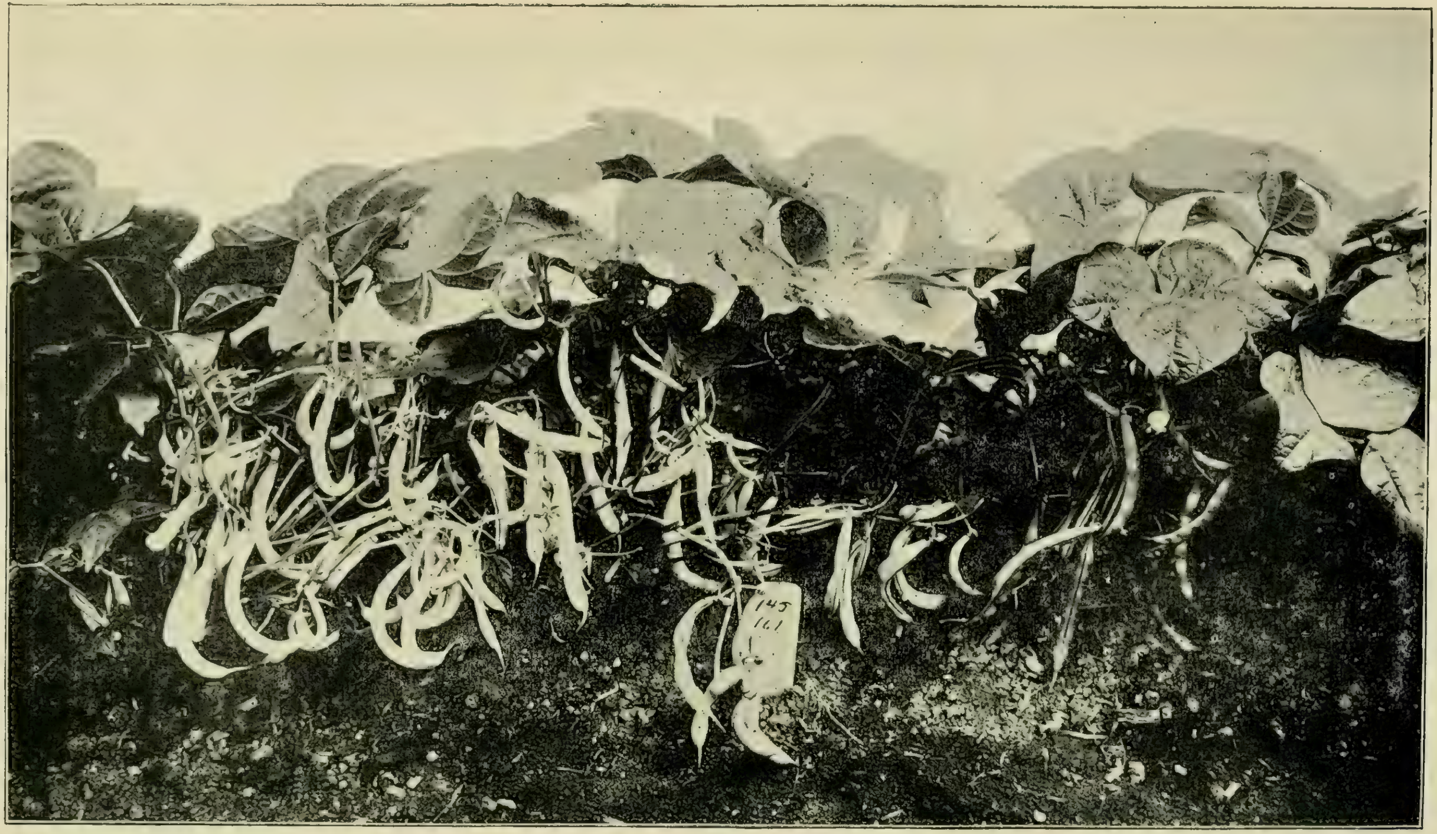

PLATE XV.

Snap Beans. Field view of cross of "Crystal Wax" upon "Burpee's Brittle," showing marked differences in shape and color of pods upon the three plants in the same row.

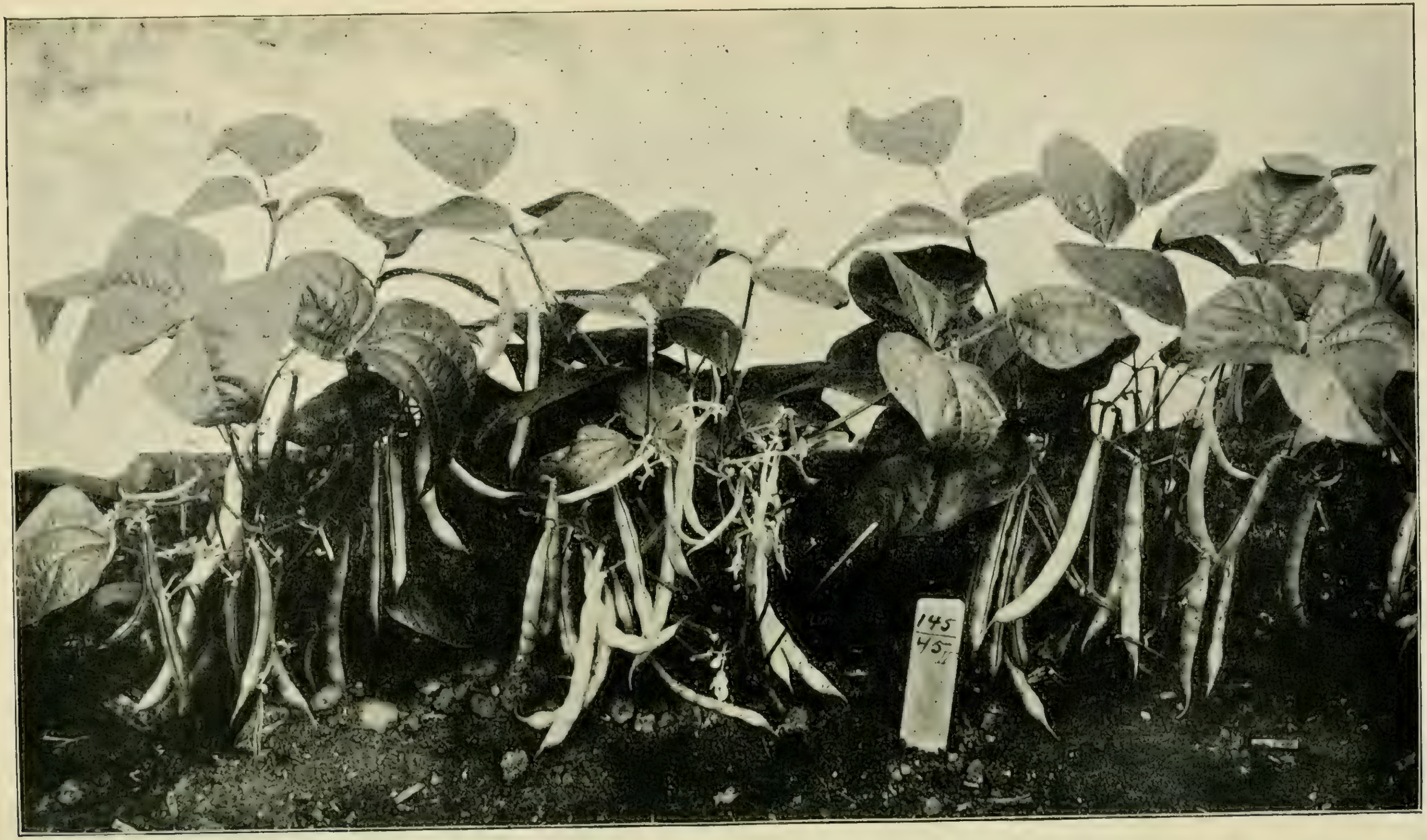

PLATE XVI.

Snap Beans. Field view of cross of "Crystal Wax" upon "Black Valentine" in its second generation.

Spraying Experiments with Bush Beans.

Forty rows of bush beans were planted July 11th for the purpose of testing the value of spraying with standard Bordeaux to check the pod spot and rust upon late-grown beans. The record numbers from 1 through 146 are of old sorts, and the following, from 165 to 194, are among the novelties, that is, not before grown in the Gardens. The following is the full list:

1. "Best of All."
2. "Bountiful Bush."
5. "Burlingame Medium."
19. "Dwarf Horticultural."
20. "Dwarf Horticultural."
26. "Longfellow."
28. "White Marrowfat."
31. "Early Mohawk."
36. "Refugee" (Green).
40. "Mammoth Stringless."
45. "Henderson's Black Valentine."
47. "Red Valentine."
48. "Red Valentine."
54. "Six Weeks."
55. "Six Weeks."
101. "Burpee's Brittle Wax."
108. "Black Wax."
109. "Black Wax."
112. "Davis' Wax."
114. "Flageolet."
126. "German Black Wax."
127. "Golden Wax."
130. "Golden Eye Wax."
132. "Keeney's Refugee."
134. "Round Pod Kidney."
139. "Refugee" (Wax).
141. "Saddleback."
144. "Wardwell's Kidney."
145. "Crystal Wax."
146. "Yosemite Mammoth."
158. "Silver Refugee."
165. "Perfection Wax."
167. "Mohawk Wax."
182. "White Kidney" (Green).
185. "Hodson Wax."
194. "Burpee's Stringless" (Green).
195. "Hodson Green Pod."
196. "Jones' Stringless" (Green).
197. "Pencil Pod Wax."

The first spraying was given upon July 19th, eight days after planting, and a half of each row was left untreated with the Bordeaux throughout the experiment. While the plan was to spray at intervals of one week, the rainy weather required some modification so that the dates of the seven sprayings were as follows: July 19th and 23d, August 1st, 4th and 13th, September 1st and 8th.

There was very little disease of any sort, in some measure due to the unusually fine seed employed. The varieties, which showed a small amount of pod spot, were the "Six Weeks," "Black Wax," "Davis," "Golden Eye" and "Saddleback Wax," and those with more of this disease in evidence were "Flageolet," "Golden Wax," "Mohawk," "Burpee's Stringless" and "Pencil Pod Wax." The kinds not mentioned above were comparatively free from the pod spot.

The rust appeared later and only in small amount upon the following varieties: "Longfellow," "White Marrowfat" and "Refugee," thus indicating that the late green-podded sorts may be the more susceptible.*

The foliage held upon the plants longer with some of the sprayed half rows than those which were untreated, but, as a whole, the test showed no practical benefit from the application of the Bordeaux mixture because of the general absence of the diseases that were to be combatted.

"Natural Suspect" Beans.

The term "Natural Suspect" is given to those apparent crosses which have occurred without previous treatment of the bloom to secure a special combination. That varieties of lima beans may mix without the aid of artificial pollination, when grown near together, and presumably through the agency of insects, is inferred from the results obtained in the case of the "Jackson Wonder" crosses.

For several years many varieties of snap beans have been grown in parallel rows uniformly two feet apart. Last year, when the first crop was gathered from a planting of these home-grown seeds, beans were found in certain rows different, not only from the parent type, but unlike any other variety in the plot.

Below are given some of the varieties which produced divergent seed types with the varying color in each case:

The "Black Valentine," "Cylinder," "Burpee" and "Davis" all gave the dark-mottled seeds as a variation from the parent type. From the "Jones' Stringless" row curious gray-mottled seeds with a dark "eye" were gathered.

The "Black Valentine" "suspect" in the second generation produced seeds of three types—black, mottled and that of the "Burpee." Judging from the behavior of "hand-worked" crosses, this result points to a mixture with a black-seeded sort like the "Bismarck," which was grown two feet from the "Black Valentine."

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*Note—The "Tennessee" and "Improved Tree" (both green-podded) grown as a second crop elsewhere in the Gardens, rusted quite badly but did not show the pod spot.

The "Davis" "suspect" gave in the second generation mottled and white seeds, while "Jones' Stringless" produced a dark brown in addition to the gray-mottled type.

So much attention was demanded by the more important "hand-worked" crosses that little time could be given to the "Natural Suspects" during the past season, but seeds have been saved for a further study of the subject.

Mature and Immature Beans for Seeds.

Upon July 20th, immature beans, freshly gathered and still quite soft, were planted with every alternate parallel row, receiving mature stock seeds of the same variety.

The object of this experiment was to observe any differences which might thus occur between the pairs of rows.

Of the eight varieties thus treated, "Bismarck," "Allan's Imperial," "Eldorado" and "White Kidney" showed no contrast in size of plant, earliness, prolificness or color of seeds.

With the "California Black" and "Davis" the immature row was the more prolific, but the opposite was true of the "Improved Tree" and "Pride of Newton."

The experiment does not show that there is much difference to be expected between the crops obtained from planting freshly-gathered seeds and from thoroughly dried commercial beans.

SCARLET RUNNER HYBRIDS.

Early last year hybrids were secured between the "Scarlet Runner" (*Phaseolus multiflorus*) and several snap bush beans (*P. vulgaris*). The differences between the parents are great, for the former is a climbing species with a profusion of blooms of a bright red (scarlet) color followed by an occasional pod bearing but few large chocolate and purple-mottled seeds, and the latter is a bush or dwarf type of the common garden bean, the particular characteristics of which are given below under the varieties that are involved in the union.

"Scarlet Runner-Tennessee" Hybrids.

The "Tennessee" is a variety of bush bean that is taller than the average of its class, bearing white flowers and long, flat green pods that produce seeds of medium size and of a light brown color. The seeds obtained from the blend late in 1905 were uniformly of a size and shape midway between the two parents and with nearly the same markings as the male parent ("Scarlet Runner"); from these seeds the present crop has been grown. In the accompanying plate, XVII., the lot of seeds that most nearly matches the blend is shown at 9. A set of thirteen piles of the first generation of the hybrid is shown from 2-14, seeds of the male parent being given at 1 and of the "Tennessee" at 15. The blend seeds were planted May 1st, and the several plants and their crop of seeds are considered in the following paragraphs:

No. 1. The first plant in the row of hybrids was of the bush type, medium-sized, with purple flowers, the seeds of which (shown at 2 in the plate) were all uniformly of the size and shape of the "Tennessee," and were solid, dark purple, looking black at a little distance.

No. 2. This was a small, early-fruited plant, the produce being only a few seeds (shown at 3), the beans having a yellowish-brown color, with a fine, indistinct mottling. There was very little in these seeds to suggest the "Scarlet Runner" parent.

No. 3. This was a small, early-maturing plant, which gave a very handsome type of seeds (shown at 4), the plumpness of which exceeded that of either parent, and in markings is quite unusual. The beans were nearly four-fifths black, with small, irregular patches of white in the area most distant from the "eye." The bright, shiny coat is in striking contrast with those of the two previously-mentioned numbers.

No. 4. This was a large, wide-spreading plant, with red flowers and dark green, curved pods. It was the most prolific member of this set and its type is shown at 5. The seeds here were very variable in size, and, being borne close to each other in the pods, have their ends of a peculiar angular form. Still more extraordinary is the color, which is a gray, with fine, bluish mottlings, becoming darker near the "eye." They do not suggest either parent and appear like a new departure in beans, the worth of which remains to be demonstrated.

No. 5. This was a medium-sized plant with red flowers and flat pods, curved and striped. The seeds were decidedly flat, after the "Tennessee" type, while the color and markings only faintly suggested the "Scarlet Runner." The background is gray and of a dull purplish red, somewhat concentrically arranged around the "eye." At 6 some of the seeds are much lighter colored than others—in fact, a few are nearly solid dark colored, as shown in the engraving.

No. 6. This was a small, bushy plant, with medium-sized pods, and at once reminded one of the "Scarlet Runner" in the color and markings of the seeds, but in size and shape it closely approached the other parent. The dark purple appears as black and the light portions shown are due to the reflected light from the shiny surface. Seeds are shown at 7.

No. 7. This was a small plant, closely resembling the "Scarlet Runner" in flower, foliage and seeds, but was a true dwarf, with a long blooming period, yielding short, flat, broad pods. The small quantity of seed secured (shown at 8) are above the average in size, and in shape and other markings closely resembled the "Scarlet Runner." Three seeds of this lot were planted in the greenhouse on August 27th and all are of the bush type, with red flowers.

No. 8. This was a medium plant, with short, flat pods, the seeds of which are shown at 9, and might well be mistaken for the blend originally obtained. These beans are medium-sized, flattish and marked with peculiar purples, dark and light, that are so characteristic of the "Scarlet Runner."

No. 9. This closely resembled No. 4, being a large, spreading plant, after the type of the "Scarlet Runner," with dark stems and foliage, with purple flowers and bearing a large number of flat, striped pods throughout a long season. The seeds, making the second largest group (shown at 10), are of good size and shape and uniformly of a dark purple color, appearing almost black.

No. 10. This was a small, early-maturing plant and strikingly different from the last in many respects, not the least being the appearance of the seeds as shown at 11, which were closely mottled and quite long and flat. The basal color is that of the "Tennessee," the somewhat concentric blotches being of a purple color. These markings are fairly-well shown in the engraving.

No. 11. This was also a medium plant, with pink flowers, medium-sized, flat, striped pods, the seeds of which (shown at 12) are longer than the average and of a dull, dark purple, with indistinct mottlings. When immature, the "Scarlet Runner" characteristics were more in evidence.

No. 12. This was a medium-sized, early-maturing plant, with red flowers, followed by short, flat pods. Its crop of seeds is shown at 13, consisting of attractively odd-looking beans, the basal color seal brown (approaching the "Tennessee"), but much mottled with a darker color.

No. 13. This was a plant with a long stem, inclined to twin, bearing white flowers and flat pods. The seeds, very few in number (shown at 14), were long and peculiar in having one end entirely white and the remaining portion pure, dark purple.

The thirteen plants, the seeds of which are figured, were divided into three groups, as follows: Small, five; medium, five, and large, three.

"Scarlet Runner-Six Weeks" Hybrids.

There were seven plants grown of the hybrid between "Scarlet Runner" and "Early Six Weeks" (63/53). The plants were all of the bush type, and two had red, three purplish and two white blossoms. The parents have scarlet and pink flowers, respectively, and the white flowers might not be expected. In shape of pod there was some variation in the length and breadth, but all were curved. Three plants had black seeds and the other four showed strongly the "Scarlet Runner" parentage in being dark mottled. The lack of inclination to "run" was manifest, and seems to indicate that the "Six Weeks" has a preponderating influence in determining the size and habit of the plant. It is not easy to account for the large percentage of black-seeded plants, for the mother plant bears light brown beans.

GENERAL NOTES UPON BEANS.

Earliness is associated with a quick-growing plant of open growth, while a late variety is usually spreading in habit, of a denser foliage, and produces more pods. The "Golden Wax" is a good example of an early variety, and the "Triumph of the Frames" is an early green-podded sort, popular for forcing.

Three types of plants are readily distinguished in the bush beans, the "Dwarf," "Standard" and "Running." Small, low-growing varieties like the last two mentioned belong to the first

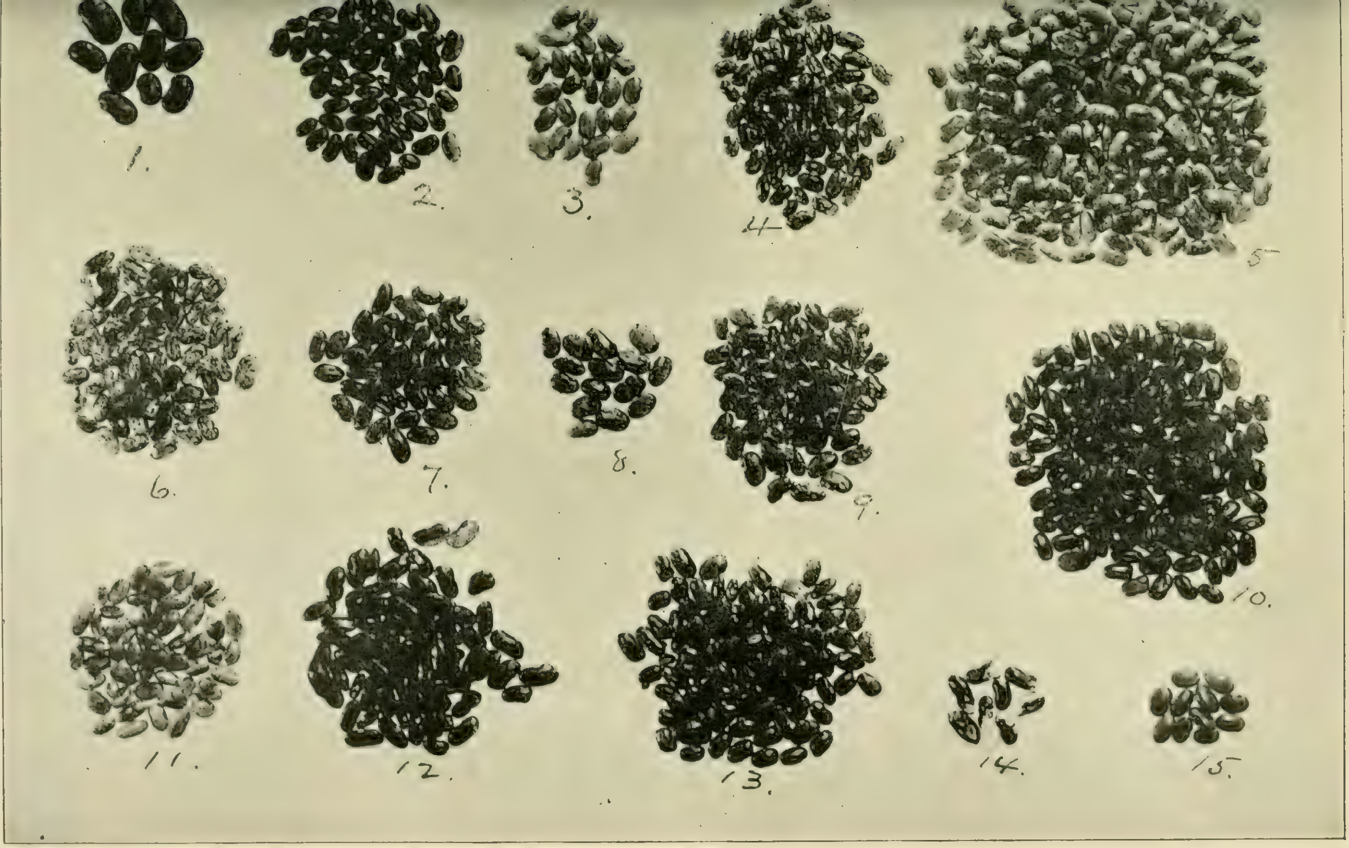
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PLATE XVII.

Hybrid Beans. Ten seeds of the male parent, "Scarlet Runner," are shown at 1, and ten of the mother variety, "Tennessee," at 15, with the crop of thirteen of the hybrid plants between them.

group. The tall bush sorts, like "Canadian Wonder" and "Burpee's Brittle Wax," may be classed as "Standards," forming the largest group, while the smallest is the "Running," and includes such sorts as the "White Marrowfat;" these varieties seem to form an intermediate type between the true bush and the pole bean.

Two distinct leaf types with intermediates are apparent, the broad, short, and the long, narrow leaf. "Wardwell's Kidney" is a good example of the first and "Keeney's Refugee" of the second type. There are also marked differences in leaf suface, whether smooth or wavy.

The plant stem, as well as the foliage, may be either a light or a dark green. A dark stalk indicates a dark-seeded parent, while a light green stalk is evidence that a white or a light colored bean has been planted.

From the color standpoint there are four types of flowers, namely, purple, pink, striped and white. The striped form seems to be rare among beans, since but one variety with that color, the "Lightning," has been grown at the Gardens. A purple flower is associated with a black or dark-colored seed; a pink blossom with a seed between the dark and the light, as the "Yellow Six Weeks," and the white flower with either a white or a light-colored seed.

Flat and round pods occur in both the green and wax varieties. The round pods have the preference because associated more with stringlessness.

Variations of the green color are the dark and the light shades with some sorts, like the "Goddard," having on the surface stripes or markings of a deeper color. The "striped" pod usually indicates a mottled seed, and may be of either the green-podded or wax type. The striped form does not appear until the pod is nearing maturity, a characteristic, for example, of the "Keeney's Refugee." The silvery-gray pod, like that of the "Crystal Wax," is another peculiar variation of the green. In the true wax beans there are the "white" and the "golden" types.

Of nine assured crosses between a white and a black-seeded variety, all gave plants in the blend bearing mottled seed. Furthermore, the red and white-seeded varieties, when united, gave a mottled seed in four and the brown and white in two instances, and the crossing of a white-flowered variety with one having a purple flower gave a purple flower in the first generation, and a green-podded united with a wax sort results in a green pod in the blend.

EXPERIMENTS WITH SQUASHES.

During 1905 thirty-three crosses of summer squashes, secured in 1903 and 1904, were grown, a full account of which, with a plate, were given in the report for last year (pages 492-497). The seeds from forty of the selected fruits of that crop were used for planting the present season. Each lot of seeds was given a separate row across a plot and containing eight hills, four feet apart. The stand of plants was satisfactory excepting in one row, which was replanted from another lot of seeds.

Some of the rows were planted with seeds that resulted from fruits grown after pollination within the plant, and these are designated by the letters C. F. (close fertilized) in the following record, while the others, being fertilized within the row, are distinguished by the letters W. R. Stakes were lettered from A. to N.N. to avoid confusion in the reference to the row in the previous year, thus: A, 5/6, type 8, C. F. I., means that in the first row seeds were planted from a rectangular, warty squash (type 8), fertilized within the plant bearing the fruit (C. F.), and of the cross of "Yellow Crookneck" upon "Long Island Scallop" (5/6). The Roman numeral indicates the row (I) from which the "handworked" fruit was selected in 1905. The following types of squashes have been determined and correspond with the engraving in the report for last year above cited:

1. Flat, smooth, not scalloped.
2. Flat, warty, not scalloped.
3. Flat, smooth, scalloped.
4. Flat, warty, scalloped.
5. Rectangular, smooth, not scalloped.
6. Rectangular, warty, not scalloped.
7. Rectangular, smooth, scalloped.
8. Rectangular, warty, scalloped.
9. Oval, smooth, not fluted.
10. Oval, warty, not fluted.
11. Oval, smooth, fluted.
12. Oval, warty, fluted.
13. "Jug," smooth, not fluted.
14. "Jug," warty, not fluted.
15. "Jug," smooth, fluted.
16. "Jug," warty, fluted.
17. Longneck, smooth, not fluted.
18. Longneck, warty, not fluted.
19. Longneck, smooth, fluted.
20. Longneck, warty, fluted.
21. "Cheese," smooth, not fluted.
22. "Cheese," warty, fluted.
23. Spherical, smooth.

The classification assumes that the flat, smooth unscalloped fruit is the simplest general type of squash, and the long, warty and fluted one the most complex. Three forms are given after the classified groups.

A. 5/6, type 8. C. F. I. There were thirty-three fruits, chiefly cream colored and flat, the leading types being 4 and 8, small and early.

B. 5/10, type 22. C. F. III. Forty-seven fruits, cream colored, flat, types 22, 3 and 16.

C. 5/12, type 6. C. F. III. Forty-five warty fruits of an orange color and somewhat variable shape around the type 14.

D. 5/12, type 22. C. F. IV. Sixty-two fruits, chiefly cream colored, of types 22 and 11.

E. 5/6x5, type 15. C. F. VI. Sixty-one yellow-orange fruits, many striped and of types 21, 3 and 13.

F. 5/6x5, type 15. W. R. VI. Fifty-five fruits, varying in color from white through orange to green, many striped. In shape they were quite evenly divided between flat, jug and long-neck form and with a small amount of wartiness.

G. 5x6/6x5, type 18. W. R. VII. Forty-four fruits, all of yellow-orange color and the parent type (18).

H. 5(6x5)5(6x5), type 16. C. F. IX. Thirty-eight fruits, quite variable in color, some dark green but in shape generally the parent type with only a few warts (13).

I. 5(6x5)5(6x5), type 16. W. R. IX. Thirty-three fruits, agreeing quite closely with the previous row. The record for last year shows that the prevailing type then was as it is now and is becoming fixed.

J. 5(6x11), type 16. C. F. X. Only twenty-one fruits, varying in color, types 11 and 3.

K. 5(6x11), type 18. W. R. X. Fifty-one yellow, warty fruits of the parent type (18).

L. 5(6x11), type 10. C. F. X. Only twenty fruits, chiefly yellow, with the types 14 and 10.

M. 6/5, type 16. C. F. XI. Forty-eight variable fruits in color and shape, many striped and some nondescript. The leading types are 16, 17, 10 and 6.

N. 6/5, type 16. W. R. XI. Thirty-seven variable fruits, cream, yellow, striped in color, and in shape types 16 and 18.

O. 6/9, type 3. W. R. XII. Forty-six fruits, chiefly white-cream in color and flat with scallop (type 3).

P. 6(5x6), type 3. C. F. XIII. Forty-three white fruits of type 3. An early and uniform row.

Q. 6(6x5), type 16. C. F. XIV. Thirty-six fruits, all white, with the general form of types 13 and 7.

R. 6(6x5), type 11. W. R. XIV. Thirty-eight fruits, all white, but variable in shape from type 1 and 3 to 21 with several not easily classified.

S. 6x5/5x6, type 15. C. F. XV. The forty-three fruits are small, usually striped with yellow and of the parent type (15).

T. (6x5)6x5, type 1. C. F. XVI. The fifty fruits vary in color from white to yellow with some striped and in shape are between type 1 and 21.

U. 6x5/6x5, type 20. W. R. XVI. The thirty-seven medium-sized plants have a wide range of colors and shapes, approaching most nearly the types 14, 17 and 15.

V. 6x5/11, type 16. W. R. XVII. The forty-nine large, medium-early, warty fruits while largely white showed cream, yellow, orange and various stripes. The forms range from flat to "cheese" and longneck.

W. 6x5/11, type 20. C. F. XVII. The fifty-seven warty fruits had a great variety in color, but the shape was quite close to the parent type (20).

X. 8/5x6, type 10. C. F. XIX. The fifty small, yellow fruits were quite close to the type 15, many, however, being distinctly "jug" like the parent.

Y. 8/12, type 3. C. F. XX. The sixty-two large, early fruits were all white, smooth and strictly of type 3. This was the most uniform of all the rows.

Z. 9/6x5, type 8. C. F. XXI. The thirty-six small, nearly smooth, fruits were of the yellow group of colors and of types 7 and 8.

A.A. 10/11, type 16. C. F. XXII. The fifty-nine medium-sized, somewhat warty fruits showed a wide range in color and in shape ranged somewhat from the parent type (16) to 14 and 17.

B.B. 10/11, type 22. W. R. XXII. The sixty early, medium-sized fruits were in large part white or cream colored, but some were yellow-orange and nondescript. The shape varied from flat to "longneck," while others were "jug" or "cheese."

C.C. 10/6x5, type 3. C. F. XXIV. The fifty-eight medium fruits were largely white and flat, adhering closely to the parent type.

D.D. 10/6x5, type 18. W. R. XXIV. The forty-nine warty, medium-early fruits were half yellow and the other portion white, cream and orange. The shape was that of the parent type (18) with few exceptions.

E.E. 11/9, type 8. C. F. XXVI. The forty-two large, early, warty fruits were chiefly orange colored and in type close to the parent (8).

F.F. 11/10, type 16. W. R. XXVII. This was a very variable row, the thirty-five medium-sized, warty fruits representing all squash colors excepting green.

G.G. 11/6x5, type 8. W. R. XXIX. The forty-eight medium-sized, early, warty fruits represent all squash colors, and in shape vary from flat to longneck, the parent type prevailing.

H.H. 11/6x5, type 16. C. F. XXIX. The yellow color predominated in the sixty-five medium, warty fruits. In shape, the two leading types were 6 and 16.

I.I. 11/6x5, type 16. C. F. XXIX. (Failed.)

J.J. 12/11, type 8. C. F. XXXI. The fifty-one small, warty squashes were all yellow or orange, like the parent fruit. In shape, there was a range from flat to "jug" and longneck, the type 8 being quite common.

K.K. 12/5x6, type 4. C. F. XXXII. The fifty-five medium, warty fruits were largely white or cream-colored, like the parent fruit, but some were orange and a few dark green. The type 4 included nearly all the species, a few being "jug" or "cheese" shaped.

L.L. 12/6x5, type 4. W. R. XXXIII. The forty-nine nearly smooth fruits were a half white or cream, like the parent, and many of unusual mixture. In shape, the fruits were about half of the type of the parent (4).

M.M. 12/6x5, type 4. C. F. XXXIII. The fifty-three fruits were mostly white, but in shape there was more variation, type 3 being the leading one.

N.N. 13/11, type 8. C. F. XXXIV. The sixty large, late fruits were all orange-yellow and long-necked, type 18.

There were twenty-five rows of plants that are marked C. F., indicating that the seeds used were from close-fertilized fruits, while fourteen rows were with plants that came from squashes resulting from a union of two plants within the row (W. R.).

The total number of squashes in the C. F. rows was 1,195, giving an average of 48.

From the W. R. rows the total was 631, making an average of 45 squashes per row.

From this is it seen that there is no marked difference in the yield between wide and close fertilized crossed squashes.

The "Jug" Type of Squash.

One of the forms of fruit that came at once prominently to view in the offspring of the cross of the "Crookneck" upon the "Scallop" in 1904 was that with a comparatively long axis and a short neck, which has led it to be spoken of as the "jug" form. It was figured two years ago (1904, Plate IV.), along with the parents, and also in the report for 1905, numbers 13 to 16, in Plate XI., where the various types of summer squashes are figured. As this seems to be a desirable type to fix, Plate XVIII. presents thirty-nine fruits from the crop for the present year. Several plants having the "jug" type of fruit have been "handworked" within the plant, and from the resulting fruits seeds have been saved for future planting.

It is observed that the shape varies greatly within the general type, but the greatest range is in color, which extends from the white, shown in several (at 10 and 20), through the yellow, orange and variously striped (6 and 9) to solid green (3 and 16). The warts are not much in evidence, and from the experience of the past few years it seems likely that smoothness of surface is a character that it is not difficult to secure by selection. The aim is to obtain a strain free from warts with a broad base and straight neck (2, 8 and 14) in the white (cream), orange and solid green colors, and at least one with the particularly attractive orange striped upon a white or cream background, specimens of which are shown at 6 and 13 in the engraving.

A more essential point in summer squashes than shape and color is earliness, which there are hopes of gaining by breeding and selection, and without loss of productiveness, which is, of course, the main desideratum. In all the squash work the attempt is being made to reduce the seed cavity to a minimum, and therefore thicken the "meat" of the wall of the fruit. In summer squashes this is perhaps not so essential as with winter sorts, the entire fruit being used, with the possible exception of the skin.

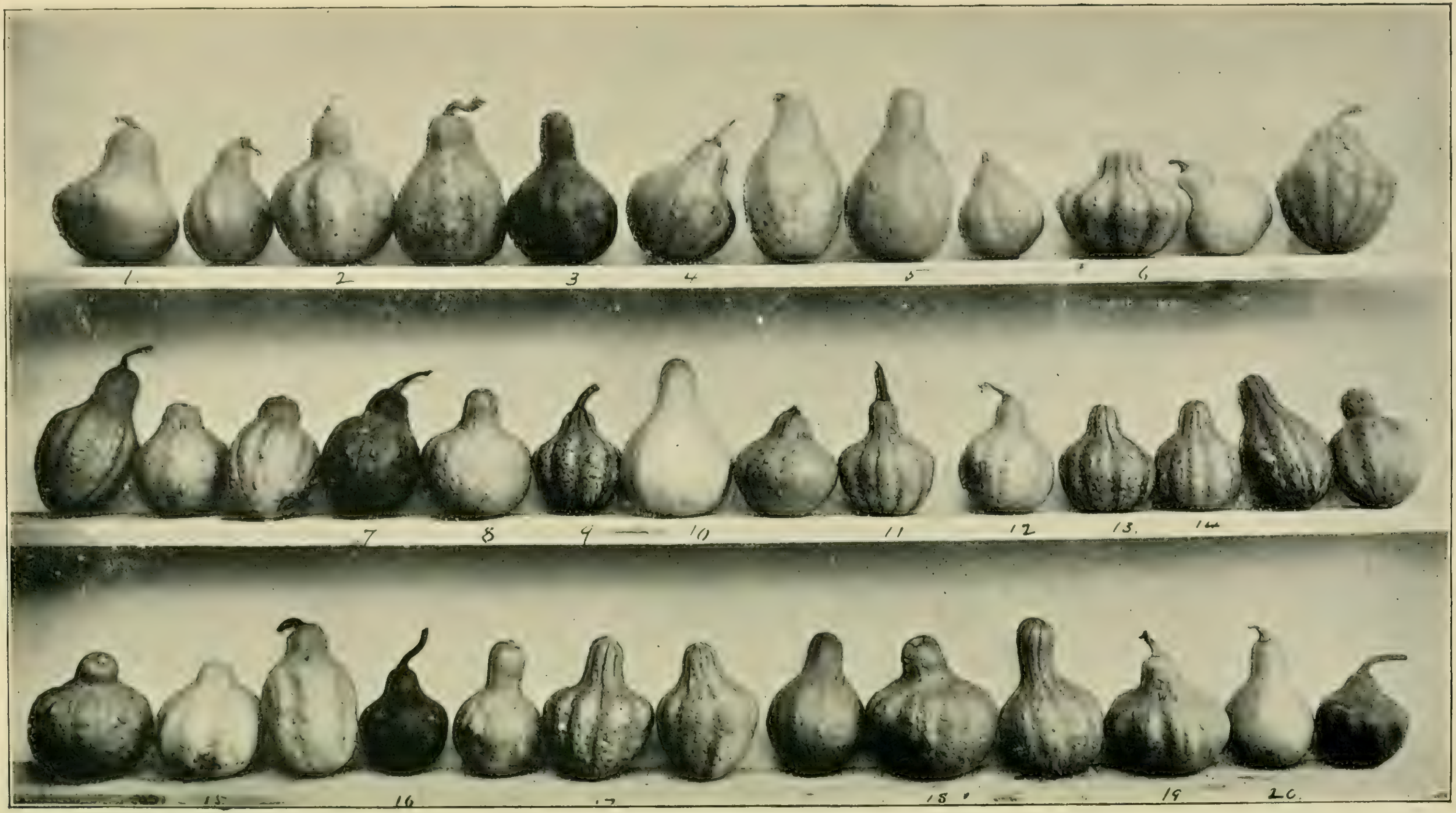
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PLATE XVIII.

Crossed Squashes. The "Jug" type of Summer Squash, resulting from the breeding of the "Crookneck" upon the "Scallop," with various colors and stripes, are shown.

Growers' Notes upon Station Summer Squash No. 1.

Packets of seeds of a cross of "Crookneck" upon "Scallop" were distributed to eighty-two persons requesting them, and below are some of the remarks received from those making the test: "Summer squash is a vigorous grower and the fruit of uniform and medium size." "Plants all very healthy." "Quality good; planted May 3d, fruited June 26th, and bore well up to August 10th." "A rank grower and very productive; extra early." "Satisfactorily productive." "Quality very good; plants vigorous and spreading; planted April 30th (indoors) and transplanted May 17th; first squash ripened July 20th." "Plants grew well and yielded well." "I cannot speak too highly of the 'Station Summer Squash;' in size, the longest I have ever grown; vigor and productiveness exceeded all expectations; shape, with one or two exceptions, perfect; color, white; uniformity and quality of fruit left nothing to be desired; it is the quickest grower I have ever seen." "Was a heavy bearer and good size, and very fine for pies; the bugs did not bother this plant, while they nearly destroyed the other kinds." "Quality of all used thus far has been good." "The squashes are doing very well." "One hill of the row seeded with seed received from you produced a large bronze-striped squash, of somewhat the pineapple shape; these I found ideal and have left to mature for seed; I think it is established as a variety, as all on the hill were always alike." "Squash was extra fine." "Vigorous growers and very productive; quality good." "Plants were very thrifty and productive." "The summer squash grew quickly; was and still is very vigorous, and productive of fair-sized fruit, which keeps tender longer than the common scallop kind." "They are all fine eating squashes and are very productive, having four to five on a vine."

EXPERIMENTS WITH WINTER SQUASHES.

Limited space prohibited the planting, with the exception of the "Japanese," of other than crosses among the vine squashes. The list that follows is arranged according to the numerator of the record fraction used in the field notes, beginning with one (1/2) and ending with 30 (30/2). Each row in the Garden proper occupied a row across a plot and consisted of five hills, nearly six feet apart in the row. Those upon the New Land consisted of four hills each, similarly arranged, and included all the crosses from K to X, letters being found less confusing than figures for stake marks and headings for notes in the record book:

A. *"Hubbard-Boston Marrow"* (1/2). The seeds used were from a striped orange and green fruit. The vines were vigorous, but showed some variation in this respect. Upon September 25th, the harvest showed fifteen marketable fruits, three of which would pass as true "Hubbard" squashes; eight were pea green, striped, large, and one bright orange. Two upon one plant were of a salmon color and are shown at 1 in Plate XIX. These agree in shape with the "Hubbard" type and may become the starting point of an attractive and superior strain of winter squashes. The pair shown at 3 were taken, along with one other fruit, from the same plant, and indicate that crosses between distinct varieties may be prolific.

B. *"Hubbard - Boston Marrow - Delicious - Golden Hubbard"* (1/2/3/4). In this combination of four varieties of standard squashes, the first two have much larger seeds than the others and in the cross the fruits bear the two sizes of seeds. Therefore, in the present instance, the planting was with the smaller seeds. The five hills produced a very vigorous set of plants that bore a remarkably variable lot of twenty-three fruits—some of them of great length and of a bright orange color, and others of a pale green and a few mottled. The disadvantage of combining four "bloods" is apparent, and the feeling of abandoning the medley is uppermost. If one seeks for varied types of winter squashes, he may well grow this combination, but to get a fixed type out of it looks hopeless. Five fruits are shown in the lower row of Plate XX.

C. *"Delicious-Hubbard"* (3/1). This cross produced a fine, even set of plants, bearing twenty-one marketable fruits, all green, but varying in the markings and general shape. The middle view in Plate XIX. shows a surface view of four of the fruits of the cross and a fifth in section. The "Hubbard" is more in evidence in the shape than the "Delicious," but in the specimen, at 6, is one quite like the "Delicious," both in shape and the flecks of lighter color, that are quite attractive. This same indication of the cross is seen in many of the fruits, as at 4, that are otherwise closely of the "Hubbard" type. From such as these the cross will be continued.

D. *"Delicious-Golden Hubbard"* (3/4). The plants were desirable and the twenty-one fruits of a good form, samples being shown at 7, 8 and 9. Nearly all of the squashes were solid dark red-orange, showing the greater strength of the "Golden," but one was green throughout, and five showed a mixture of green with the prevailing orange. Some of the fruits were quite long, and, as a rule, the neck was evident, the shape of the "Delicious" being controlled by the "Golden Hubbard."

E. *"Delicious-Bay State"* (3/21). The "Bay State" has a somewhat cheese-shaped fruit of a bluish green color, and therefore the prevailing color of the cross was, as expected, a rich light green, to which the flecking (due to the "Delicious") added an attractive marking. In size the squash is medium and in shape flat, without the angularity of the "Bay State." A sample of the thirty fruits is shown at 5, Plate XX., and a section of another at 6. The flesh is of a desirable rich orange-green and the quality superior, and in keeping qualities it is also very promising.

F. *"Golden Hubbard-Hubbard"* (4/1). The plants of this cross did not do well and only a few reached the bearing age. One of the largest squashes of the season was produced here, "Hubbard" in shape and blotched with green and orange. There were eleven marketable fruits in all, varying in markings from solid green to those that were nearly pure dark orange, and, in shape, generally longer than the "Hubbard," with the prolonged, free and curved tip.

G. *"Golden Hubbard-Boston Marrow"* (4/2). The plants were feeble and many of them perished early in the season. Only two fruits were obtained, both orange, and closely adhering to the "Golden Hubbard" form—that is, long and pointed.

H. *"Golden Hubbard-Warren"* (4/7). There was a poor stand of plants and the soil was not favorable for squashes. Only three fruits reached maturity, two of which were shaped somewhat like the "Warren" (cheese), somewhat ribbed and having green stripes upon an orange background, excepting at the blossom end. The navel of the "Warren" was somewhat in evidence in sectional view, which also shows a fine, thick flesh. Two of the fruits of this cross are shown at 1, in Plate XXI.

I. *"Golden Hubbard-Faxon"* (4/30). This row showed so few seedlings that the hills were replanted upon July 6th, and from the latter some quite large fruits were obtained, there being a total of fifteen, all solid, bright orange and resembling the male more than the mother parent. The "Faxon," as grown last year, gave a small, nearly smooth, flattish fruit, with the stem set upon the smooth upper end, and this form of stem was evident in the cross, giving the general shape of the "Delicious" to the fine, smooth, orange fruits. The flesh is uniformly of the same color as the surface and with abundant large, white seeds. The keeping qualities were not good, but the fruits were perhaps not fully matured at harvest time, owing to the replanting and shortened season.

J. "*Warren-Boston Marrow*" (7/2). A few plants were especially vigorous, but the majority were overtaken by the stem grub and perished. There was a replanting upon July 6th, from which a dozen marketable fruits were obtained, but were not sufficiently mature for seed-saving. The best hill of the original planting gave eight fruits, all of the same color (cream-orange), quite like the "Boston Marrow," and in shape a blend of the "cheese" of the "Warren" and the broadly obovate of the "Marrow." Of the twelve fruits suitable for seed-saving, five showed a well-defined navel and seven none, but the latter had a flat blossom end, unlike the "Marrow" type, and there was therefore not a uniform blending of the two forms of ends above mentioned.

K. "*Warren-Japanese*" (7/31). This, and all the following crosses, were grown upon the New Land, and had less favorable conditions than obtained upon the Garden proper. The vines were slow in getting a start, but finally made a large growth and covered the ground. At harvest, upon September 25th, thirteen fruits (all of good size) were secured, two of which are shown at 5 in Plate XXI. Nine of the fruits were orange colored, considerably ribbed and of the shape shown in the left one of the pair at 5. By comparing this with samples of the "Japanese," shown at its left (30), it is seen to be much larger, less ridged, not sunken at the stem or blossom end, and with the stem long and comparatively slender, like the mother parent. Three of the crossed fruits were quite nearly like the "Japanese" in general outline, and one, shown at 5, was nearly green and smooth, and having an unusually long stem. In sectional view the fruits all showed a medium-thick flesh and an indication of navel in the grain, and coloration of flesh at the blossom end in eight, while four had a distinct navel showing upon the outside. These little plants had but few plump seeds and these were all of large type, similar to the "Warren," but lacking the white color of the latter. The seeds in the fruits of the "Japanese" type were numerous and small.

L. "*Japanese-Mammoth Chili*" (15/16). Eight fruits of marketable size were obtained from this set of hybrid squashes, six of which were solid dark green and two entirely orange, and in shape uniformly oval and somewhat ribbed, two samples of which are shown at 6. The largest orange fruit had a thickish flesh of the

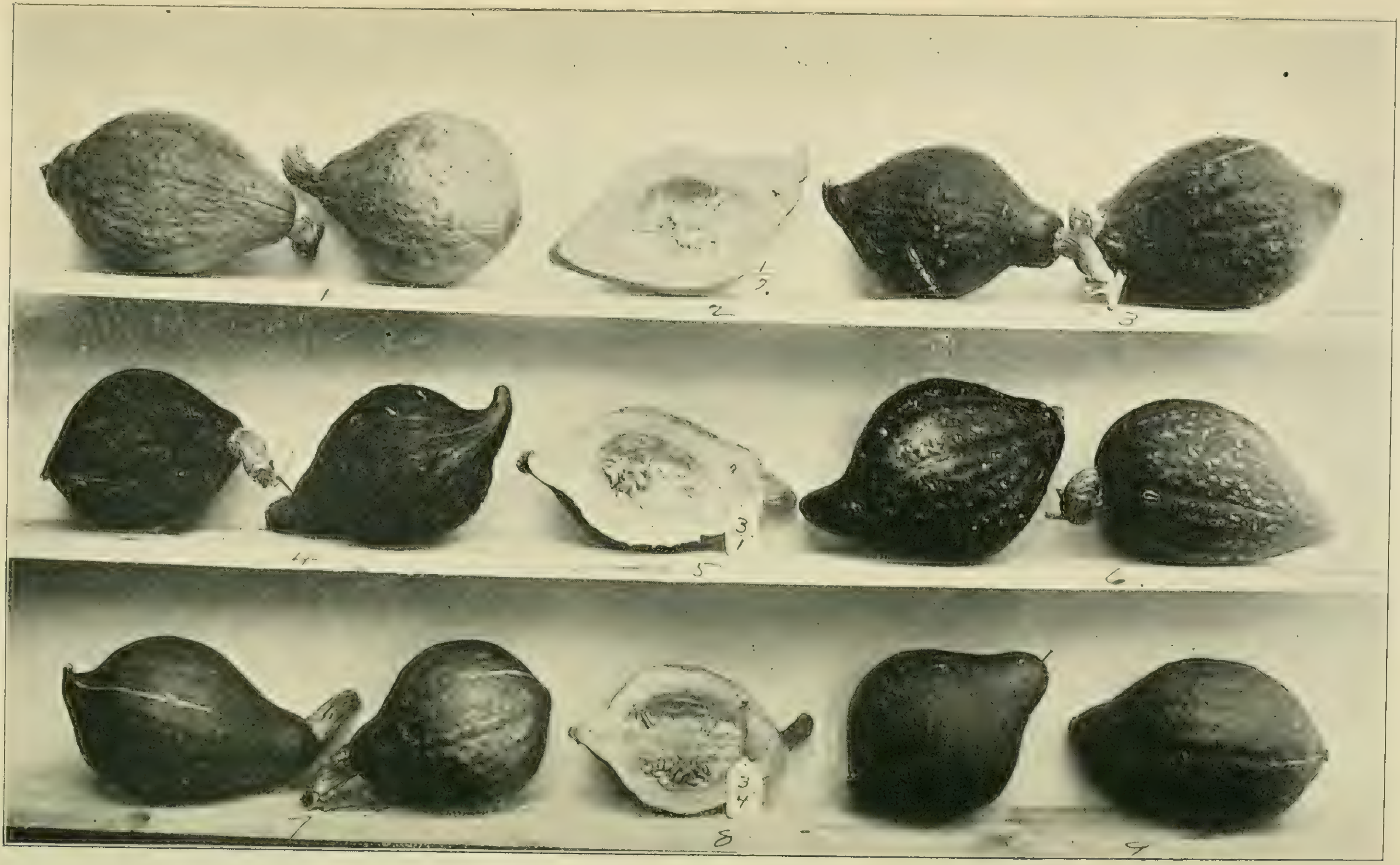

PLATE XIX

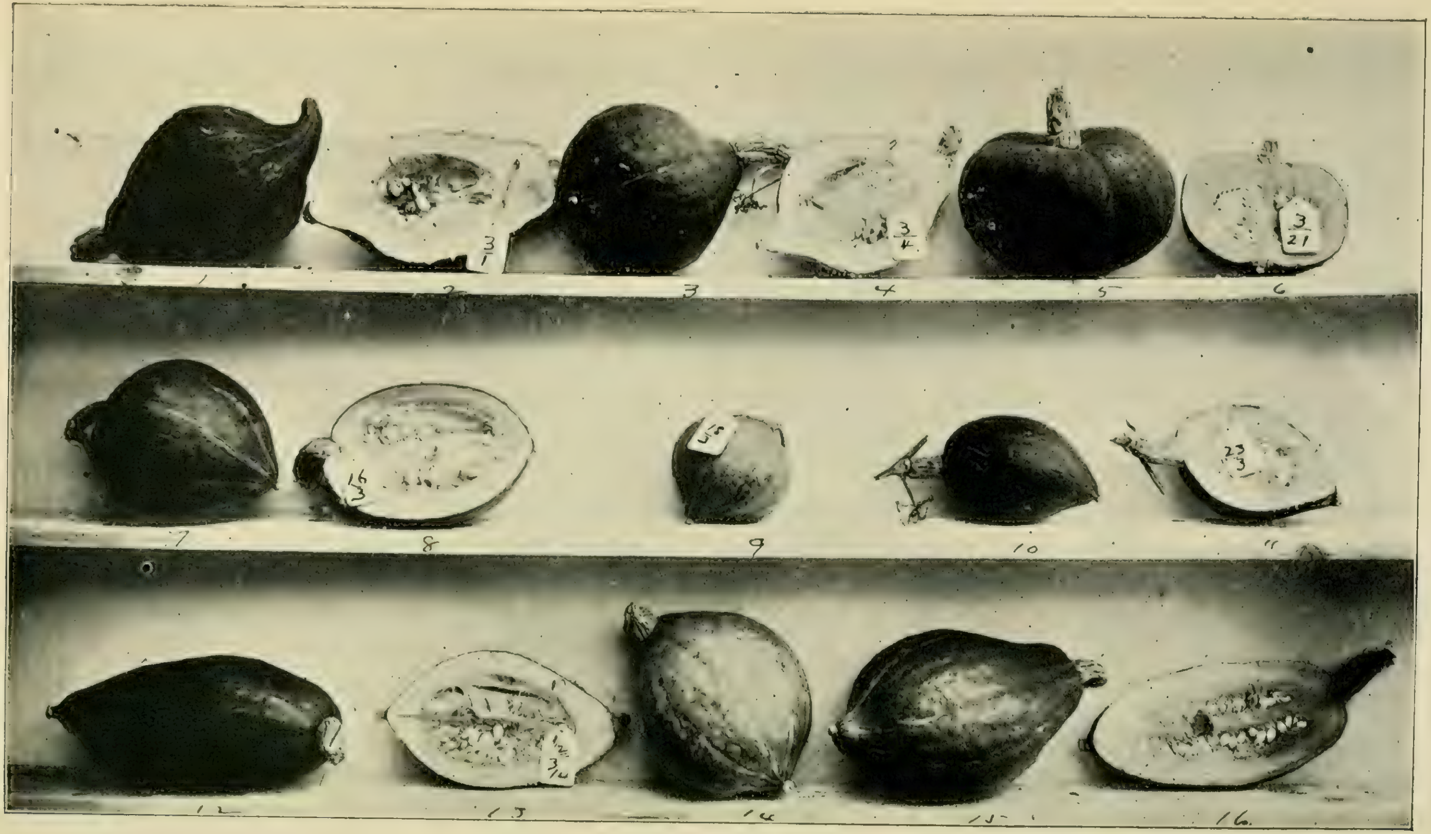
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PLATE XX.

Crossed Squashes. All the fruits here shown have more or less of the "Delicious" blood; the one at the upper right hand corner being with the "Bay State," and a special favorite.

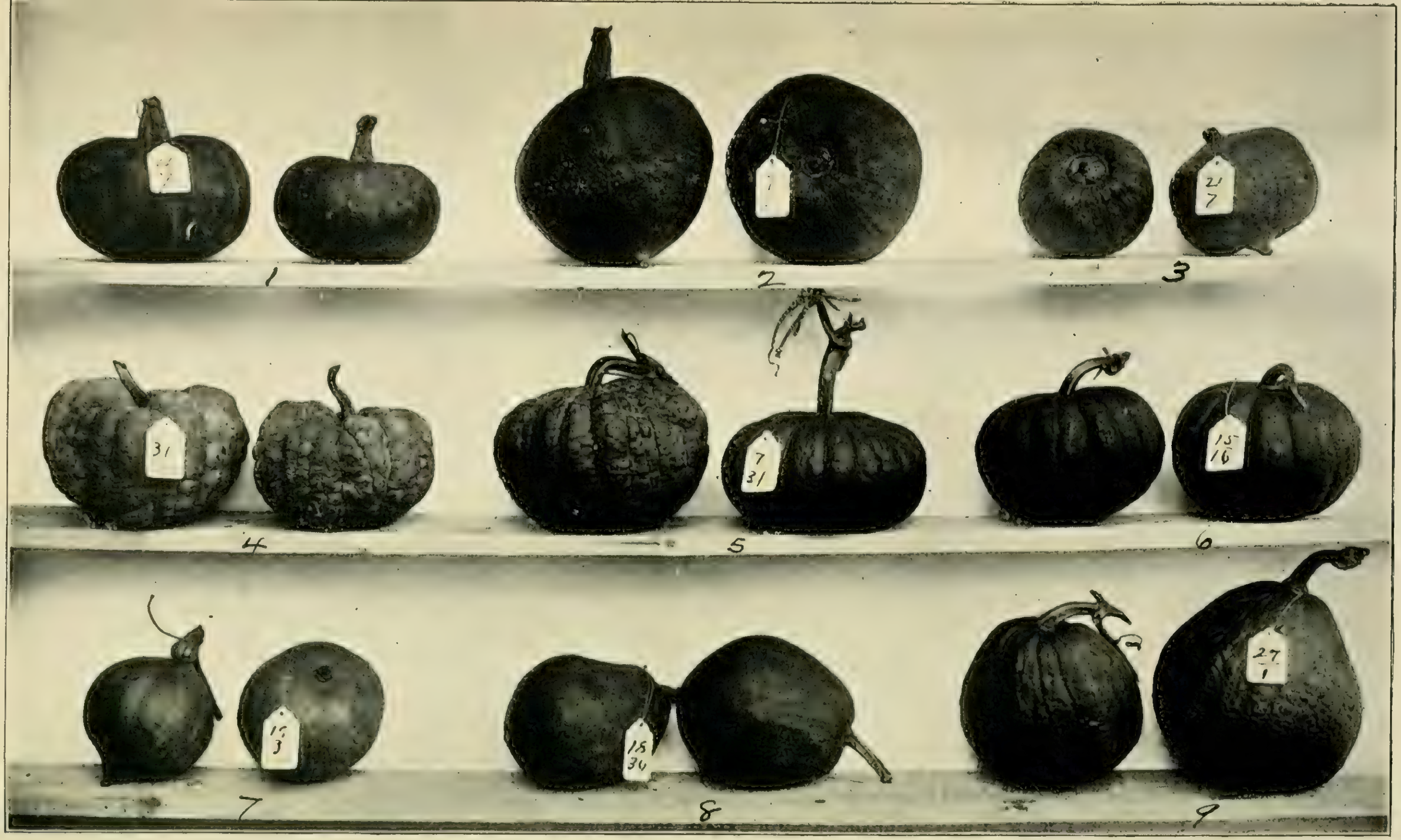
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PLATE XXI.

Crossed Squashes. The upper row contains three crosses with the "Warren;" the middle row those with the "Japanese" sort, and in the lower are those with the "Winter Crookneck" and "Canada Crookneck" upon "Delicious," "Faxon" and "Hubbard."

same color as the exterior and a strong "pumpkin" odor when opened, showing a large, nearly empty, seed cavity. Only an occasional plump seed was met with, among them many that were full-sized were empty.

M. "*Mammoth Chili-Delicious*" (16/3). Only three fruits of this cross were obtained, two of which are shown at 7 and 8, in Plate XX., and all pale green, with indistinct stripes. The shape is the peculiar obovate (spade) form of the mother parent, but evidently the fruits would attain to much larger size under favorable conditions. The seeds, produced in abundance, were in size midway between those of the two parents. For its pleasing pea-green color, handsome markings, attractive shape and thick golden flesh, this cross offers much of promise, provided the table and keeping qualities equal those of the mother.

N. "*Mammoth Chili-Japanese*" (16/31). This, from all points of view, seems to be fully "Japanese," there being some possible error yet undetermined.

O. "*Winter Crookneck-Delicious*" (18/3). The harvest from this cross was exceedingly meager, there being only three small fruits, all of a pink-cream color with pale green markings. One of these fruits is shown at 9, in Plate XX., and two at 7, Plate XXI. The shape is seen to be a broad one, with a pointed blossom end with the stem medium stout. The flesh is only of average thickness, of a dull orange, with a green streak near the surface. There was an abundance of seeds, which were larger than the dull, white male parent and smaller and less "chalky" than the mother.

P. "*Winter Crookneck-Faxon*" (18/30). Here, again, the crop was small, no doubt due in large part to the unfavorable conditions of the soil. The crop consisted of eight medium-sized fruits, two of which are shown at 8, Plate XXI., and all were light orange with a handsome, fine netting of a darker shade of orange. In shape the fruits varied slightly from ovate, with sometimes a little suggestion of a "neck." The stems were slender and of the "Crookneck" type, while the flesh, fairly thick, was of deep orange, detracting nothing from the attractiveness of the squash. The seeds, very few in number, are quite like the "Crookneck" in size and shade of gray.

Q. "*Bay State-Warren*" (21/7). Only one hill produced any sizeable plants and from this three small squashes were secured, two of which are shown at 3, Plate XXI. They were pale cream colored with green around the very large, pea-green navel. The shape, as might be expected from that of the parents, is nearly that of a "cheese," with a long, medium-slender stem (not shown entire in the engraving). The flesh is a pale orange (lemon), very thick upon the blossom end, and with much green in the region of the navel. Only a small number of seeds was matured.

R. "*Golden Bronze-Delicious*" (23/3). Only two small fruits of this cross were secured, and are shown at 10 and 11, Plate XX. They were of a dull ("dirty") bronze upon a pea-green background, while in shape they resembled the mother, with the flesh very thick and fine-grained, and a rich orange with a thin green layer beneath the skin. The section of the fruit gives many details of the interior.

S. "*Marblehead-Warren*" (24/7). No mature fruits were secured from this cross.

T. "*Dunlap's Marrow-Winter Crookneck*" (25/18). The four small fruits of this cross were all broad oval, and orange, striped with a lighter shade of orange, with the thick flesh of the same color and a broad seed cavity, nearly free from contents, the seeds being very long, and possibly all without vital embryos.

U. "*Warted Hubbard-Dunlap's Marrow*" (26/25). The five fruits secured were all dark orange, with green stripes, and of the "Hubbard" shape. The flesh was thick, pale green near the outside, but orange further toward the center. Seeds were abundant.

V. "*Warted Hubbard-Essex Hybrid*" (26/28). Four oval-flattish fruits were obtained, all of which were pale green, with an inclination to develop cream stripes. The thick, firm flesh was green for a half inch from outside and then light orange inside to the seed cavity, giving a particularly attractive interior, made somewhat irregular by the presence of the navel, that, with one exception, was large and showed a peculiar projection nearly an inch long.

W. "*Canada Crookneck-Hubbard*" (27/1). This hybrid did better than many others upon the poor land and developed its large, dark green fruits quite early in the season. Two specimens are shown at 9 in Plate XXI., where it is seen that the shape is ovate, indistinctly ribbed with a slender stem of the "Crookneck" type. The flesh is uniformly light orange and thin, giving a large cavity, in which but few seeds were developed. The seeds, only a few being plump, are larger than the "Hubbard," and gray and dark-rimmed, like the "Crookneck."

X. "*Faxon-Boston Marrow*" (30/2). The two oval-flat fruits from this cross were small, pea-green and orange-blotched, the green making up the narrow stripes. The flesh was thin and orange colored. There was not enough ground for an expression of an opinion as to the merits of the combination.

Growers' Notes upon Station Winter Squash No. 1.

A hundred and thirty-four packets of the cross of "Hubbard" upon "Boston Marrow" were distributed to testers last spring, but at the time of writing only a few have reported upon their results. The following notes show that some were pleased with the cross: " 'Winter Squash' was of excellent quality, medium in size, yellow in color." "Large, strong vines." "Quality is very good and the shape is fine." "Size medium, fair in vigor and productiveness." "Medium size, strong grower, very productive; fifteen nice squashes; quality excellent; cook fine and dry; in my opinion, they are superior to the 'Warted Hubbard' that I raised in the same ground." "Plants have done well; vines strong, vigorous growers." "Healthy and vigorous vines; one vine has eighteen squashes on it, varying in size from tiny ones to about twelve inches around." "Vines are vigorous and healthy." "Squash very productive, vigorous growers and fruit very uniform; from all indications it will become a leading squash for market growers." "The 'Station Winter Squash' has fully equaled our expectations; vine a strong, vigorous grower; I have about twenty squashes, varying in size from twenty inches to twenty-nine inches in circumference; the shape is very uniform, practically the same as the 'Hubbard;' there is quite a variation in color of some."

Notes upon Squash Seeds.

The following are some of the observations made upon the seeds of the vine squashes in connection with those of the crosses that have been secured the present year in their first generation from the blend. Following the order of the numerators (beginning with the lowest) of the fractions expressing the crosses that are represented in Plate XXII., the first cross is "Golden Hubbard" (4) upon "Hubbard" (1). In this cross (4/1), in the first generation after the blend, the seeds in each fruit are of two sizes—a large and small—as shown at 2 and 3, the seeds of the parents being at 1 ("Golden Hubbard") and 2 ("Hubbard"), respectively. It is noted that the seeds of the cross are not of sizes and forms that agree with either parent. At 5 and 6 are shown the seeds from the same fruit—a cross of 4, above named, upon "Warren" (7), and here (4/7), again, there are two sizes, which are not closely adhering to parental types.

In the plate the plan is to show five seeds of each commercial sort that is involved in the crosses represented and ten seeds of each cross, some of the latter being separated into two sets of five, each representing differences where these are apparent. At 7 is shown a set of ten similar seeds that are a cross of the "Golden Hubbard" (4) and "Faxon" (30)—4/30. The seeds of both parents are chalky white, with the one longer and the other broader than the average of the two, as shown in the crossed seeds. The cross at 9 is similarly a combination between two kinds, with no marked difference in their seeds.

The seeds at 11 are of a hybrid between the "Warren" (7) upon the "Japanese" (31)—7/31—and they are quite midway between the two, the "Warren" being large and chalky, while the mother (31) has very small seeds for a vine squash, and of a brown color and a distinct rim. The outer coat in the hybrid seeds is brown and rimmed. In another fruit, from the seeds of the same mother fruit as the last, the seeds (12) are scarcely different from the "Japanese" alongside at 13, and do not show indications of hybridity. The seeds at 14 are shells merely, from a full-grown fruit of "Japanese" (15) upon "Mammoth Chili" (16), and are practically the same as of the mother, plump seeds of which are to their right. That it is safe to infer the size and shape of plump seeds from empty seed coats is demonstrated in nearly every squash fruit, for there are frequently a large fraction without embryos, and they agree with plump ones in external qualities. In the cross of 16/3, "Mammoth Chili" upon "Delicious," there is a marked difference in the seeds of the two parents, and here, again, from the same fruit two sizes and shades of color also are separated, as shown at 16 and 17.

At 19 is a group of ten seeds from a fruit that was grown from seed secured by breeding the "Mammoth Chili" upon the "Japanese," but the seeds do not differ materially from the mother species.

A hybrid between the "Winter Crookneck" (18) and the "Delicious" (18/3) is shown at 21. The seeds (20) are white, like the mother, but much smaller, and are in striking contrast with the "Crookneck," which are more oval, flat, brown and rimmed. The above "Winter Crookneck" upon "Faxon" (18/30) gave seeds brown and thin (22), resembling in these respects those of the male parent as shown at 20, which were very unlike those of the plump, pure white, smooth ones of the mother shown at 31.

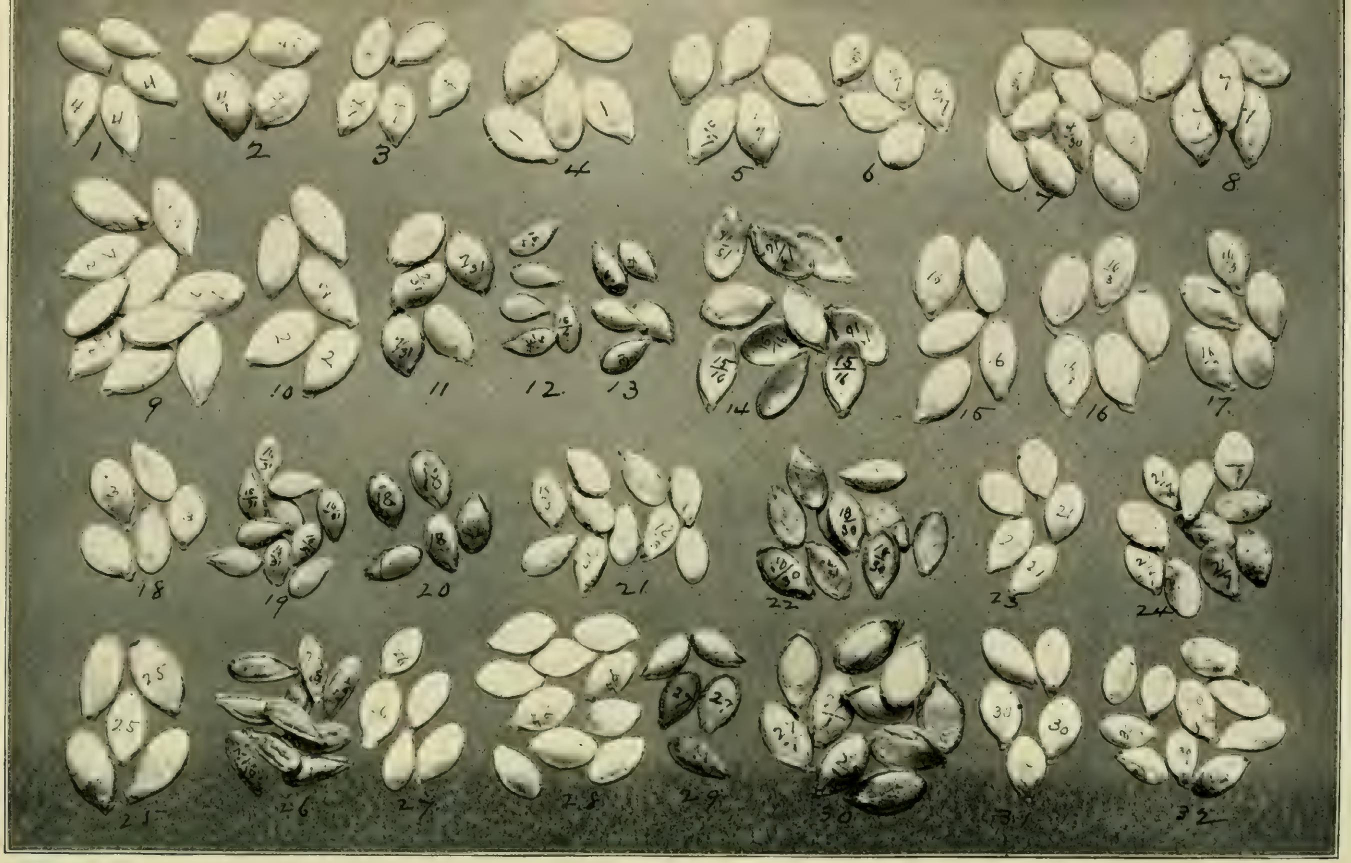
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PLATE XXII.

Squash Seeds. The seeds of various combinations among Vine Squashes are shown along with the seeds of the parent varieties.

At 24 is shown ten seeds of 21/7, that is, “Bay State” upon “Warren,” in which the male type of seed is closely adhered to. “Dunlap’s Marrow” (25) upon “Winter Crookneck” (25/18) gave only empty seed coats, but these, as shown at 26, were remarkably long, but in other respects closely resembled the mother (18).

The cross between the “Warted Hubbard” (26) upon “Dunlap’s Marrow” (26/25) gave handsome, broad, pure white, medium-sized seeds, shown at 28, not agreeing with the characteristics of either parent, but favoring the father.

The large, brown, rimmed seeds shown at 30 resulted from the breeding of the “Canada Crookneck” (27) upon the “Hubbard” (27/1), the seeds of the male parent shown at 29 being much smaller than those of the hybrid, but otherwise similar. The white of the “Hubbard” is entirely lost.

The last cross shown in the plate is of “Faxon” (30) upon “Boston Marrow” (2). Here both parents have chalky-white seeds, but differ in size. From the same fruit two types of seeds could be easily selected, as shown by the two groups of five each at 32.

EXPERIMENTS WITH PEAS.

The following list of commercial varieties of garden peas was grown in limited amount during the present season:

1. “Abundance.”
2. “Alaska.”
3. “Alpha.”
4. “American Wonder.”
5. “Black-Eyed Marrowfat.”
6. “Champion of England.”
7. “Daisy.”
8. “Daniel O’Rourke.”
9. “Duke of Albany.”
10. “Duke of York.”
11. “Dwarf Champion.”
12. “Everbearing.”
13. “Extra Early Exonian.”
14. “First of All.”
15. “Gradus.”
16. “Gray Seed (Mammoth).”
17. “Gregory Surprise.”
18. “Heroine.”
19. “Horsford’s Market Garden.”
20. “Melting Sugar.”
21. “Nott’s Excelsior.”
22. “Philadelphia Extra Early.”
23. “Premium Gem.”
24. “Pride of the Market.”
25. “Prince of Wales.”
26. “Shropshire Hero.”
27. “Sutton’s Excelsior.”
28. “Sutton’s Satisfaction.”
29. “Telegraph.”
30. “Telephone.”
31. “Thomas Laxton.”
32. “Thorburn’s Extra Early Market.”
33. “White Marrowfat.”
34. “Witham Wonder.”
35. “Yorkshire Hero.”
36. “Tom Thumb.”
37. “Prosperity.”
38. “Prolific Early Market.”
39. “Ameer.”
40. “Admiral.”
41. “French Canner.”
42. “Dwarf Gray Seeded Sugar.”

A set of these seeds in four-ounce bottles has been placed in the Museum for future reference, and some herbarium specimens were secured of the plants grown in the Garden.

Attempts at cross breeding were made between the following kinds, which were grown in pairs of parallel rows, planted early in the season:

"Abundance"–"Admiral."
"Alaska"–"Tom Thumb."
"Alaska"–"Telephone."
"Alaska"–"French Canner."
"American Wonder"–"French Canner."
"Daniel O'Rourke"–"Surprise."
"Horsford's Market"–"First of All."
"Black-Eyed Marrowfat"–"Prosperity."
"Excelsior"–"Prosperity."
"First of All"–"Telephone."
"Nott's Excelsior"–"Gradus."
"Thomas Laxton"–"Telephone."
"Ameer" (a few plants alone).

The following suspected crosses were planted June 29th, from which a few seeds were obtained:

1/41—"Abundance/French Canner."
2/41—"Alaska/French Canner."
14/5 —"First of All/Black-Eyed Marrowfat."
14/21—"First of All/Nott's Excelsior."
14/30—"First of All/Telephone."
15/36—"Gradus/Tom Thumb."
21/41—"Nott's Excelsior/French Canner."
30/21—"Telephone/Nott's Excelsior."
30/41—"Telephone/French Canner."
31/14—"Thomas Laxton/First of All."
36/38—"Tom Thumb/Prolific Early Market."
39/1 —"Ameer/Abundance."
39/36—"Ameer/Tom Thumb."
39/41—"Ameer/French Canner."
40/41—"Admiral/French Canner."
41/4 —"French Canner/American Wonder."
41/15—"French Canner/Gradus."
41/30—"French Canner/Telephone."

The summer season is not, of course, favorable for peas. It was particularly noted that plants having the "French Canner" "blood" represented were unusually strong.

In Plate XXIII. seven crosses of peas are represented, they

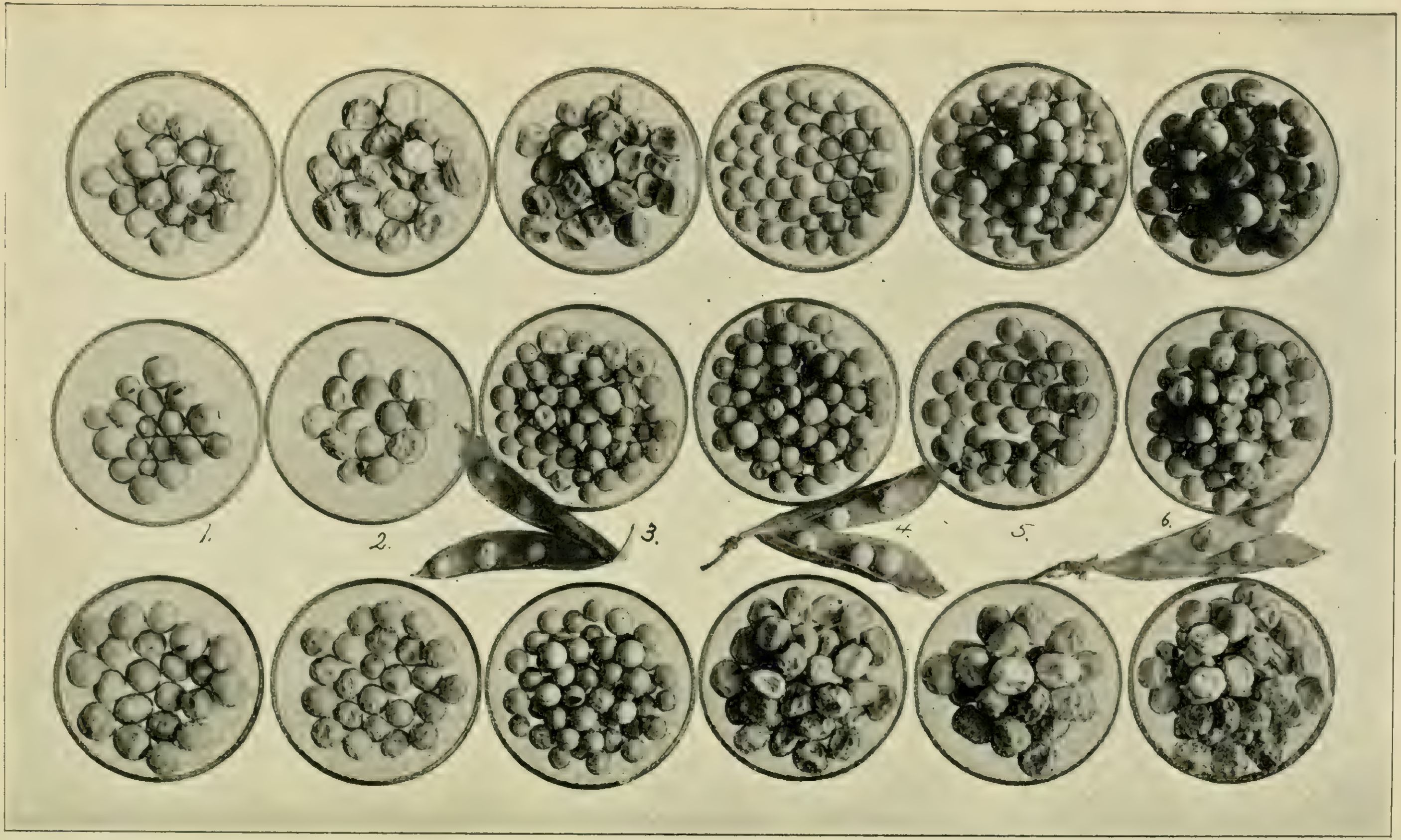

PLATE XXIII.

Pea Crosses. The seeds of the crosses occupy the middle row of watch glasses, and the male parent is given above and the female below each cross, respectively.

occupying the middle row of watch glasses from left to right. The parents of each are placed with the male above and the female below the cross. For example, the first cross (shown at 1) is that of "First of All" (14) upon the "Black-Eyed Marrowfat" (5). The seeds of the parents are alike in being buff (light tan) colored, but with the latter much larger, less wrinkled, and having a characteristic dark eye, giving the name to the variety. In the cross shown above the latter the seeds are nearly midway in size between the two parents, but they all have the eye-marking of the mother parent.

In the next cross the male parent, "Thomas Laxton" (31) has a quite large and very much wrinkled seed, frequently retaining a greenish color, while the mother is the "First of All" (14), as named in the last cross, and has a medium-sized, often nearly smooth, seed. The seeds of the cross are midway in size of the two parents, and show (2) some seeds fully wrinkled, like the "Laxton," while others are smooth, as in the "First of All."

The "Admiral" (40) upon the "French Canner" (41) combines two varieties representing two widely different types. In the former the seeds are large and extremely wrinkled and of a dull greenish buff color. The "French Canner" has small, spherical, typically smooth seeds that are nearly flesh colored. The differences in the plants of these two sorts are as great as here shown at 3 between the seeds. The cross is near the mother in size of seeds, three-quarters of which are smooth, somewhat larger than the "Canner," but greenish like the "Admiral." It is interesting to note that the wrinkled are larger than the smooth ones. A pod is shown with the five seeds in plate, the second one from the base being larger than the other and dimpled.

At 4 is shown the seeds from a plant that grew from a pea obtained by breeding the "French Canner" (41) upon the "American Wonder" (4). Here, again, the two parents represent the two classes shown in the last cross but with the "Canner" in this case as the mother. The results are nearly the same, for the small, spherical, smooth pea seems to reduce the size to nearly that of its own, the wrinkled ones being somewhat larger as shown in the sample and also by the dimpled seed in the opened pod. The seeds from one of the first generation plants were classified as follows:

Smooth,	Gray,	Large	62
Smooth,	Gray,	Small	19
Smooth,	Green,	Large	10
Smooth,	Green,	Small	6
Wrinkled,	Gray,	Large	12
Wrinkled,	Gray,	Small	10
Wrinkled,	Green,	Large	6
Wrinkled,	Green,	Small	2
Total			127

Smooth, 97; wrinkled, 30; large, 90; small, 37; gray, 103; green, 24.

This follows, as closely as might be expected, the numerical results determined by Mendel. Regarding size in the case of peas, it is not always easy to decide to which class a wrinkled seed belongs, and, again, the end peas in a pod frequently vary in size from the others. It remains to be seen what the sizes in the plants from these peas will show as the standard and dwarf types are brought together.

At 5 is shown the seeds of a cross of the "French Canner" (41) upon the "Telephone" (30) and represented by the fraction 41/30. As in the last, the mother variety is one producing a large, green, wrinkled pea, but, unlike the "American Wonder," the "Telephone" is a standard sort. Only a few seeds were secured in the fall crop of the first generation, but they show all the types brought out in the scheme given for the last cross.

The last cross, shown in the plate at 6, is that of a purple flowered plant growing in a mixed crop of peas and oats, "handworked" upon "Horsford's Market" (19). Of the eighty-four seeds secured, sixty-one were smooth and twenty-three wrinkled, sixty-six gray and eighteen green, sixty-one large and twenty-three small, which is a fairly close approximation in Mendelism. The various types of seeds are shown in the watch glass at 6 with an opened pod below with smooth and wrinkled peas in place.

There are several other crosses, not represented in the plate, showing very striking differences in types of seeds borne upon the same plant; that of "Nott's Excelsior" (21) upon the "French Canner" (41) perhaps will afford a most interesting set of plants in the next generation, as the contrasts of the parents are, of course, very great.

EXPERIMENTS WITH SALSIFY.

Plot 4, Series IV., was sown to salsify June 27th, 1905. In nearly all instances the seed used was obtained by placing paper bags over young heads of the mother plants, and therefore the offspring were bred within the single inflorescence. The numbers used below are those of Prang's Color Chart.

Row 1. The easternmost part of the plot was sown with seed obtained by placing a large bell jar over the plants, thus securing crossing between plants of two types, namely, 95 (light yellow) and 61-y (darker orange, yellow orange). The record for this row is that the plants were much mixed in color.

Row 2. This was sown with seed from a solid row of selected plants of 93 (yellow). This is the color carried by one of the parents of the hybrid, namely, the wild species (*Tragopogon pratensis*). This row of thirty feet was divided into ten sections, each of which was sown with seeds from different close-fertilized heads. No two sections in this row were alike in characteristics of the plants but extremely uniform within the sections from any head. Thus, some sections were with smaller plants than others; some had smooth leaves, others with wavy margins to the foliage. Some sections showed purple in the stems while others were green throughout. In short, there were many indications that all the plants were hybrids. The only characteristic in which there was constancy was the color of the flowers. It was a solid yellow row, and, with a single exception, all the ten sections showed the same shade; the second section of over four feet had a lighter shade of yellow—No. 94 of the Prang Chart.

Row 3. This was made up of five sections, all quite different in color value, but the whole row showed a very much mixed display of flowers.

Row 4. This consisted entirely of 41-y (darker orange, red orange), and proved to be a mixed lot when in bloom.

Row 5. This was sown with seed of No. 31 (darker red orange), and while the four sections differed from each other in many things, the blooms were all true to the type of the mother plants.

Row 6. This had 31y (darker red orange) for one portion and 21 (dark red, red orange) for the other. The former had a few yellow (93) blooming plants among these, otherwise true to seed sown. All of the row having No. 21 was solid of the kind of the parent.

Row 7. While this row was sown with seeds from six heads of the same type—21-y (dark red, red orange)—no two sections were alike, and in three the blooms were mixed. The finest plants were in the second section, from which seed from bagged heads was saved. The general type here was of the garden species, with no sign of purple in the stem or leaf, but differing greatly in the color and size of the flowers. It was a very distinct hybrid that is full of promise.

Row 8. This was made up of four sections, all sown with seeds from heads with color, dark red (12). With the exception of one plant, the parent color was present in all the offspring in the first two sections. In the third section there were no two plants alike, suggesting that in this instance there was an error, and the head used had not been covered during the season of bloom.

Row 9. This was sown with No. 242 (dark red, red violet), and in the first section there was a large percentage of the same type, save with the yellow eye (242-y). The same was true of the third section, where 60 per cent. were 242-y. In the last two sections the plants were all solid 242.

Row 10. This was sown with No. 233 (red violet), and made a remarkably strong line of plants. In the third section, while nearly all were true to parent, a few had a yellow "eye" (233-y), two were with nearly white flowers, and one a most delicate shade of peach. All the plants in this row had but few (15 to 20) ray flowers with the long tips of the involucre extending beyond the rays, giving a striking "starry" appearance. The next section of twelve feet was unusually fine, approaching the garden species, having leaves very glaucus, no purple in stems or foliage, with the flowers solid 233 and coiled inward in a most peculiar manner.

Rows 11, 12 and 13 were made up of several shades, all of which were quite close to the parent type.

Row 14. This was sown with 234 (light red violet), and consisted of seven sections; they all came true to parent type.

Row 15. This was sown with seed gathered from plants of No. 95 (yellow), confined under mosquito netting during the blooming period. The plants were all true to parent color (95), but were evidently a combination in many respects of the two species involved in the hybrid.

Row 16. This was sown similar to the above with seeds obtained from plants of No. 234 (light red violet), confined under mosquito netting. Here, again, the blooms all came true to the parent color (234), while in other respects the plants were a true hybrid that approached the garden species.

Row 17. This was sown with seeds obtained in an attempt to cross the wild upon the garden species. The flowers were all yellow and not of the colors that had been obtained in hybrids of previous years.

Row 18. This was sown with seeds obtained in an attempt to cross the Black (Scorzonera) upon the Wild Salsify. All were with yellow blooms of the wild type.

Row 19. This was sown with seeds obtained in an attempt to cross the wild upon the black species. No hybrids were in evidence.

Row 20. This was sown with seeds obtained in an attempt to cross the black upon the garden species. All were straight garden salsify plants.

Several rows of hybrids of the wild and garden species were grown from seeds perfected in the open and the number of types and shades were as published in tabular form for last year, pages 502–506.

Salsify in the Old Plot.

Hybrid salsify has been left to take care of itself for six years upon a half plot of the Gardens.

Upon May 25th, the number of plants with yellow (93) flowers was 345 to 125 of all other colors. Upon the following morning, the yellow flowered plants counted were 444, and those of all other colors 182. Of the latter only 12 were of the Garden parent, namely, light violet, red violet (224), while 146 were dark red, red orange (21), of which 121 were with a yellow center ("eye") to the head. The twenty-four remaining plants represented fourteen shades of color.

It is seen that the area is rapidly running toward the yellow (93) color of the wild parent, while the color (224) of the cultivated species is poorly represented. The large number of the shade (21) with a yellow "eye" is noted.

The study of the salsify hybrids has illustrated the remarkable variation in color caused by a union of two species widely different but very constant in the color of their respective blossoms. At the present stage of the experiment it seems quite probable that any shade that has come to view may be fixed by close fertilization (that is, within the head), and it is inferred that many other minor qualities may be secured in like manner.

The experiment was beset with unusual difficulties in the weediness of the plants, their wide dispersion by the winds and the difficulty of protecting any uncovered seed from sparrows and other birds. It was discontinued, not from lack of interest, but because it was becoming something of a nuisance.

NOTES UPON UDO.

The twenty-five Udo plants came safely through the winter, with only a little cover of coarse manure, and made a vigorous growth. Unfortunately the cover was removed too soon and the blanching of the stems was confined to only a few plants, over which barrels were placed.

Cuttings were made upon April 20th and the stalks, prepared like asparagus, proved to be of superior quality. In flavor, the Udo is somewhat like that of a parsnip, but of a more delicate character, with possibly a little of a balsamic taste. As the aralias are closely related to the caraway and celery, the flavor is one that some may not like, while others will be partial to it.

Upon May 5th, a quantity—sufficient for twenty persons, were the material asparagus—was cut and a few shoots were photographed. Some of the stems, taken from under the barrel, were over two feet long, and in some instances an inch and a half in diameter at the base, while the leaf stalks were a half that size and bleached and very tender. Such leaf stalks quite resemble celery in appearance, but are more cylindrical and longer, equally tender and particularly toothsome when eaten raw.

The lower parts of the stems, as shown in Plate XXIV., may be cut six or more inches long, to be bunched, as is the practice with asparagus. Stems of Udo have whatever there is of woody tissue near the outside—the stem being of the exogenous type—while the center is as tender as the flesh of a ripe pear, which it resembles when freshly cut. The Udo stems hold their shape

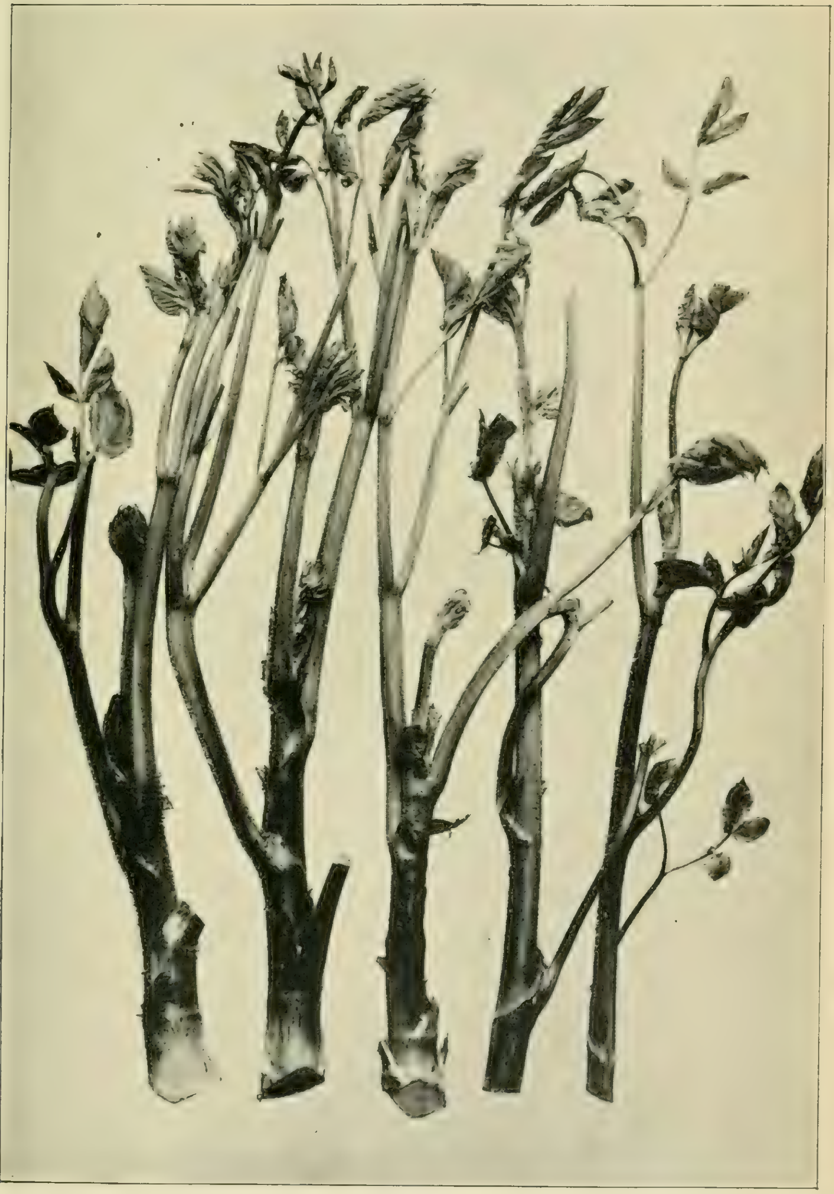

PLATE XXIV.

Japanese Udo. Five of the blanched spring stems and leaves are shown.

well in cooking because of the softest part being within, and may be served the same as asparagus, but without the woody base, so objectionable with the latter vegetable.

The midsummer growth of the Udo was not satisfactory, the plants being infested with a blight that caused the leaves to turn brown, and before the season was through the whole group of plants was nearly leafless. Flowers failed to form, with few exceptions, and no seed was gathered. It is likely that spraying will check this disease, but it was purposely withheld. There is fear that the Udo may have a serious enemy in the blight in question, the exact nature of which is under consideration.

CHINESE VEGETABLES.

Eighteen packets of Chinese vegetable seeds (Numbers 17858-17953) were received last spring through the courtesy of the United States Department of Agriculture, and some of these have shown qualities deserving special mention. The U. S. D. A. 17867 is a cabbage-like plant, particularly as to the smooth, waxy blade of the leaf, the midrib of which is very large, nearly white and resembles that of the Swiss chard. Professor Bailey* figures this under the name of Pak-Choi. Six specimens of differing ages are shown in the upper half of Plate XXV. The plant at 1 has been cut lengthwise through the center to show the pure white interior, made up of the younger leaves with their coral-like stalks and midribs. It is these pure white-leaf stalks and the smaller leaves with them, making up an interior similar to a "head" of lettuce, that are used for the table and may be prepared in the same manner as cabbage or cauliflower and make a very acceptable substitute for either. It may be used in the raw condition, similar to celery, in the making of salads. At 2 a smaller plant is seen tied with a tape ready for the market, and strings have been placed around the much-spreading leaves of smaller plants at 3, 4 and 5 to draw them together for the more complete bleaching of the interior during the latter portion of the plant's stay in the ground.

A few of the plants sent up flower stalks, and, by midsummer, had matured a crop of seeds, the main portion of which was harvested, but, from those that became scattered upon the ground around the parent plants, new seedlings grew that throve during the autumn months and produced plants for the table. It was from this second crop from self-sown seeds that the specimens were gathered for the picture shown in the upper row of Plate XXV. Similar plants left longer in the ground became of large size. The Pak-Choi is particularly well adapted for an autumn crop in our climate.

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* "Some Recent Chinese Vegetables." L. H. Bailey. Bulletin No. 67, New York (Cornell) Experiment Station, June, 1894.

The second vegetable worthy of mention came from U. S. D. A. 17865, which Professor Bailey figures in the above-mentioned bulletin under the name of Pe-Tsai, concerning which he writes that it "is properly an annual, which has the habit of a giant lettuce * * * and needs a moist and cool soil for its best development." In the present test the seeds of this vegetable (as also Pak-Choi) were sown in the greenhouse and the seedlings transplanted, as in the case of ordinary cabbage, to the open, when they came forward rapidly and produced plants with many large, lettuce-like leaves having broad white midribs and altogether weighing three or more pounds. Small second-crop plants from the self-sowing of seeds from matured plants in midsummer are shown in the lower half of Plate XXV. As in the case of Pak-Choi, the plants are with wide-spreading foliage and it is well to tie the leaves together for the purpose of more thorough blanching, as the plants approach the time for gathering.

The differences between the two cabbage-like vegetables are very apparent when grown in the field, but, as arranged for the combination picture, their likeness is great. It will be observed, however, that the lower row shows leaves that have the blade reaching to the base and the upper ends are irregular like lettuce, while, in the upper row, the stalk extends several inches below the blade, the latter being quite thick and smooth. In short, the Pak-Choi (upper row) is quite like a cabbage in color and texture, while the Pe-Tsai might well be called a giant lettuce.

Both have been grown side by side and the volunteer second crop occupied, without order, the same land, and in practical outcome there is very little difference, and, by an occasional plant of the fruit crop producing seed, these vegetables can be easily propagated, and, thriving in the cool months of late autumn, may deserve a place in the home garden as well as the field of the trucker.

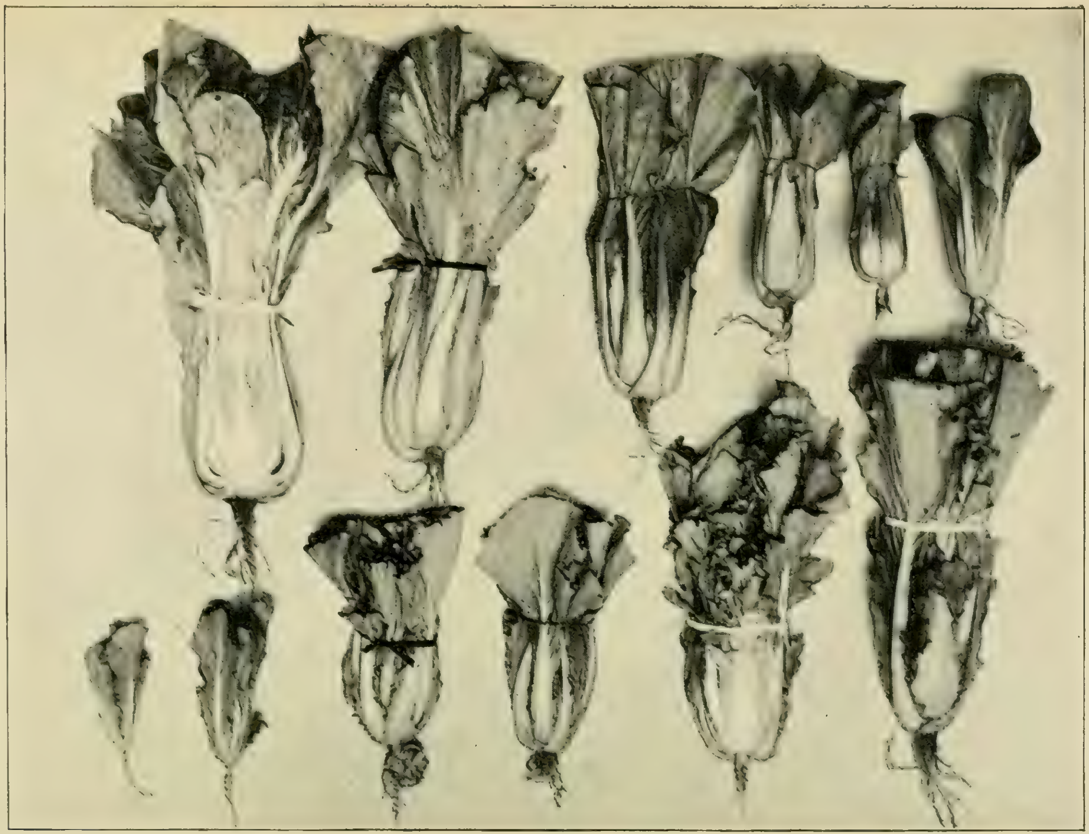

PLATE XXV.

Chinese Vegetables. The " Pak-Choi " is shown at different ages in the upper row, and " Pe-Tsai " is similarly displayed in the lower part of the plate.

EXPERIMENTS WITH OKRA ("GUMBO").

The okra as a vegetable is, perhaps, less known in the State than it deserves. Frequently visitors to the Gardens have there seen the growing okra plants for the first time, while others quickly recognized them as special favorites. The latter were usually from the South, where this garden crop, aften called gumbo, is much more commonly grown than with us. Okra is the subject of a bulletin* by Mr. Beattie, who states that it has been in use in Europe for centuries, and is of tropical origin.

The okra (*Hibiscus esculentus*) is a member of the mallow family, and shows close kinship to cotton, various abutilons, marshmallows and similar giant-flowered plants of the hollyhock type. It is an annual with straight, large, stiff stems, bearing large "maple-shaped" leaves and the funnel-shaped, lemon-colored flowers, followed by pods that sometimes attain a length of nearly a foot. These pods are the portion used, and need to be gathered only two days or so after the flower has passed, when they abound in a mucilaginous substance that imparts a pleasant consistency as well as flavor to soups.

The crop is easily grown, and as the ordinary sorts attain a height of three or more feet, and bear large, broad leaves, the plants need more space than onions or bush beans, and do their best when at least two feet apart each way. There are dwarf sorts that may be given less space.

Through the kindness of Mr. Beattie, seeds of a number of types of okra plants were obtained, and although some sorts did not germinate, by supplementing the list from the commercial seedsmen, several varieties were grown.

From the okra plants grown last year selection was made of a standard sort with long, slender pods, and of a dwarf form of plant with shorter, thicker pods. Seed from each was planted this season and designated as "Home" (standard) and "Home" (dwarf), respectively; the former produced tall plants bearing long, thin pods, while the latter twenty-one plants all bred true to type, that is, were low plants with short, thick pods, and one plant bore slender pods.

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* "Okra: Its Culture and Uses." W. R. Beattie. Farmer's Bulletin No. 232, U. S. D. A., 1905.

"Kleckley's Favorite" produced plants of medium height and white pods of medium length.

"New Lady Finger" gave dwarf plants with very long, curved, slender pods.

"Dwarf Prolific," represented by only one plant, was medium in height with short pods, and dark green in color.

"Dwarf 3291," with but one exception, conformed to the dwarf type of plant, and produced pods of medium length, dark green before ripening.

The above varieties gave three general types of pods: (1) long slender; (2) medium slender, and (3) short thick, which varied in color from a dark green to white (or cream).

From Mr. Beattie's bulletin the following classification of the okras is developed:

- Plants, Standard—
  - Long pod
  - Short pod.
- Plants, Dwarf—
  - Plants dark green
    - Long pod
    - Short pod
  - Plants pale green
    - Green pod
    - White pod.

The standard type has plants from four to eight feet tall, while the dwarfs are usually less than three feet high. The latter are divided upon the color of the foliage, one group having the ordinary green foliage of the standards, while the other has a lighter prevailing color in the leaves. A pod is long when exceeding seven, and short when less than five inches. In the last-named group with pale green plants, the pods are slender, and the name of "Lady Finger" is given to them; they are divided into those with green and others with white pods.

The varieties grown in the Gardens furnished representatives of all the six groups in the above classification, excepting the last, which is a dwarf, with pale green foliage and a slender white pod. One of these, the "White Louisiana," is recommended as among the best for cultivation, the leading one for general use being the dwarf green, long pod.

EXPERIMENTS WITH ONIONS.

In the spring of 1904 onion sets of the "White Globe," "Yellow Globe" and "Red Globe" were obtained from a seedsman making a specialty of growing pure strains of this vegetable and were planted in double rows so that the flowers of two varieties could be easily cross-pollinated. "Suspect" seed was obtained as follows: "White" upon "Yellow," "Red" upon "White" and "Red" upon "Yellow." From this "suspected" seed bulbs were obtained in 1905, and these have been grown for seed the present season. The flower "balls" were covered with large paper bags before blooms appeared and removed after the seed had set. This seed, resulting from fertilization within the plant, may be the starting of new types of onions.

From commercial onion sets of "Michigan Red" and "Southport Yellow" "suspect" seed was obtained as follows: "Red" upon "Yellow" and "Yellow" upon "Red."

These last-named bulbs were grown alongside of the set previously mentioned, but they were much smaller in flower stalk and cluster than those of the home-grown bulbs.

Seed onions were obtained for further breeding of the "Michigan Yellow Globe," "Southport Red Globe" and "White Globe." While the soil is not of the best for onions, there are certain plots in the Gardens that will permit of the breeding of this vegetable.

EXPERIMENTS WITH ORNAMENTAL PLANTS.

A small portion of the Gardens was devoted to ornamental plants, with which some attempts were made in breeding.

Antirrhinum (Snap-Dragon).—The "Dwarf White" and Standard Red" were grown with the object of crossing the two. The dwarf form with its compact growth and showy flowers makes a desirable bedding plant and continues blooming until late fall.

Dolichos.—Four varieties of this flowering bean were grown, "Giant Crimson," "Dwarf White," "Purple Soudan" and "Standard White." "Purple Soudan" differs from the "Giant Crimson" in its dark stem and foliage, darker flowers and purple pods; the "Giant Crimson" comes into bloom earlier. For early bloom the "Dwarf White" is desirable, but the "Standard White" excels in its profusion of white flowers, borne ten feet from the ground and lasting for a long time. Pods white.

Hibiscus (Golden Bowl).—Plants from four to five feet tall, bearing large, showy flowers resembling the okra. "Suspects" have been obtained between it and the okra.

Ipomoea (Morning Glories).—At the "Camp" about twenty varieties were grown. They made a large and rapid growth of from ten to fifteen feet and their profusion of rich bloom was arrested only by frost. Forty-one crosses were obtained among them (including reciprocals and some duplicates). One plant showed a decided tendency to form what are known as "double flowers."

The normal plants from the same packet of seed had nearly white flowers that were under the average size for the species and the bell-shaped corolla did not flare, and therefore is somewhat near the tubular type of blossom. In addition to this, there were five long red splashes equidistant upon the corolla, one upon the upper portion of the midrib of each petaloid leaf composing the corolla. These color marks are of interest in the study of the doubled blossom. In the calyx the chief change from the normal in the flowers in question was the abbreviated lobes which were half the usual length. The many parts to the corolla caused the buds to be very plump and the petals showed their crumpled edges for some days before the full bloom appeared.

Upon looking down into the flower the style and fine stamens were seen to be normal in all visible respects. The five innermost parts of the corolla were broader than any other, long, spatulate and blotched with red near the geographical middle of the broadened upper end and arranged equidistant like the points of a star. These, it seems probable, were the parts that correspond to the middle of each of the five equal parts making up the ordinary corolla.

The blotched petals may be easily separated from the others by a downward pull, but, along with each, a cluster of adhering fine petaloid white parts is removed. The stamens alternated with the blotched petals as they do with the lobes of the normal corolla.

It is evident that the fine, fluffy, chrysanthemum-like appearance of the doubled morning glory was caused by a supplemental growth from the outside of the ordinary corolla, there arising from near the base of the tube a large number—fifty or more—slender, often hair-like petaloid structures, which, being enlarged and more or less coiled at the upper end, gave a very unusual not to say surprising array of blossoms that were so evanescent that only with much difficulty could the delicate parts be arranged in the press. Their capacity in breeding is problematical.

Convolvulus minor.—This is a dwarf Morning Glory with large, handsome flowers borne in profusion. Attempts have been made to breed it with the twining species of the genus.

"Jerusalem Cherry."—Plants of dark green foliage, small white flowers and cherry-like fruit, turning red at maturity, making the plant quite ornamental. A "suspect" was obtained between it and the "Garden Huckleberry."

Lathyrus.—Started early in the greenhouse and came into bloom late, after the Sweet Peas had ceased blooming. It is desired to cross this with the Sweet Pea with the object of obtaining a scented Perennial Pea.

Lavatera.—A promising cut flower with flowers resembling the hollyhock, but much smaller. Attempts are being made to cross this with the mallow pest of the garden and field; also, with the Malope.

Malope.—Plant resembles Lavatera; flowers also, in form, but much finer in coloring, being of a rich red.

Poppy.—Single Red, Double Red, Shirley and Mexican varieties were grown, and attempts made to cross them.

Petunia.—Dwarf Star fine for bedding, but does not always come true, many of the flowers being purple. "Single Fringed" seems to be an excellent variety. Flowers changed their coloring through the season, being richer and darker in the autumn. "Giant Crimson" gave some plants with flowers of the "Standard Crimson." "Giant Quadricolor" is a very showy flower, with plants less hardy than the other varieties. The two leading species have been grown side by side the present season, and they seem to hybridize with ease. Several capsules of seed, through "hand-working," have been secured. The several plants of the commercial sorts furnished a subject for the study of variability, and a set of the different types of stem and foliage was secured for the Herbarium. One plant, in particular, might be considered a mutant, so widely different was it from the others. The plant in question was wide-spreading and low, the leaves of which were not half as large as the average, and arranged without the usual length of internodes. These characteristics gave the plant a striking appearance and, in addition, while the plants upon all sides bloomed freely, this one did not produce a single flower bud. For the purpose of ordinary petunias—that is, garden display of various shades—this plant was, of course, a failure.

Sweet Peas.—With the hot days of summer all the varieties died down. The "Cupid" dropped its buds just before blooming. All attempts at crossing were unsuccessful.

TEST OF RUST-RESISTING CANTALOUPES.

Through the kindness of Professor P. K. Blinn, of the Colorado Experiment Station, a quantity of a Rust-Resisting Cantaloupe* was received by this department and distributed to growers who make a specialty of this crop. The demand for this seed was so great that a request was made for a supplemental package, but as the supply of the seed of the desired kind was exhausted, Professor Blinn kindly forwarded a generous supply of the "Pollock Strain of the Rocky Ford Cantaloupe," and this was freely distributed in liberal packets.

Twenty-four New Jersey citron growers received both the "Rust-Resisting" and "Pollock Strain," and seventeen additional truckers had only the latter, making in all forty-one persons who made the test.

It may be well to include here a copy of the letter of transmissal of both the "Rust-Resisting" and the "Pollock Strain" of Cantaloupes:

February 8th, 1906.

Dear Sir—The Experiment Station has just received some seed of the "Rocky Ford" Cantaloupe from the Colorado Experiment Station. It is claimed that this seed is from plants that are strongly resistant to disease, and I am desirous of testing it in fields along with cantaloupes of the ordinary sorts, to determine whether this strain is of special value for "citron" growers of this State.

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* "A Rust-Resisting Cantaloupe." P. K. Blinn., Bulletin No. 104, Colorado Experiment Station, November, 1905.

The seed in question is from plants that were selected some years ago because of their fine health when growing in the midst of other muskmelon plants that suffered badly from disease, and the offspring bred within themselves seem to have the resistant power well fixed under the conditions obtaining in Colorado.

Please indicate upon addressed postal card whether you can give the seeds a thorough test. Any names of large melon growers who have suffered from blights, etc., you may be pleased to send me will aid in extending the trial.

Yours very truly,

——— ———.

FEBRUARY 16th, 1906.

DEAR SIR—In response to your generous request to make a melon (citron) test as suggested in my letter of the 8th inst., it gives me pleasure to send you herewith a packet of the "Rust-Resisting Cantaloupe" from the Colorado Experiment Station.

It is desired that these seeds be planted and the plants therefrom treated in every way the same as those of the general stock that you grow. It would be well to plant the seeds so that the vines from them may be surrounded by the other cantaloupes.

Furthermore, it is desired that observations be made upon the plants from time to time, and particularly as to the amount of disease they show as compared with the plants surrounding them. Should the vines in question prove superior, it scarcely needs be written that seed should be saved from the best mature fruits.

Yours very truly,

——— ———.

MARCH 9th, 1906.

DEAR SIR—Since the small packet of "Rust-Resisting Cantaloupe" seed was sent to you, I have received from the Colorado Experiment Station a more liberal supply of the "Pollock Strain of Rocky Ford Cantaloupe," and it gives me pleasure to enclose a packet of the same.

This last strain is of very high quality, as grown in Colorado, and it may show much merit in New Jersey. It is not claimed to be as rust-resisting as the first-named, but is less susceptible than the ordinary sorts to disease.

Please find a place for both samples in your melon fields, and be upon the watch for points of superiority.

Any report upon your tests will be gladly received by the Experiment Station.

Yours very truly,

——— ———.

From the reports submitted the following remarks are extracted: "As yet we note no difference in the 'Rust-Resisting Cantaloupe' from the other varieties." "The 'Rust-Resisting' strain lived for ten days after our 'Jenny Lind' died and then succumbed to the excessive rains; the 'Pollock' strain also lived well; we think that these strains of blight-resisting cantaloupes promise much." "I would say the seed you sent me shows as little blight as any of eight different kinds of seed I planted." "I planted one row in the middle of the patch and I cannot find one hill but that shows some rust or blight, neither do I find one hill with a crop of citron on it; four citron seems to be the highest number on a hill; I would not think them worth much as a cropper." "In regard to 'Rocky Fords,' crop was medium, cantaloupes were quite uniform in size, well netted and good flavor, very few culls; vines looked well all the season but are about dead now; cantaloupes began ripening about August 10th and continued to September 10th, but were not picked as often as they should have been." "The 'Rust-Resisting' seeds are doing fine and show no signs of rust." "The 'Pollock Strain of Rocky Ford' have made a very rapid growth and first fruit will be ripe in about three days. There is only one hill of rust showing, which I think is very good, as they have never been sprayed; they have set more fruit than the other vines and especially earlier fruit." "None of the 'Rocky Ford' melon seed did well in our soil; possibly the season was not suitable." "There were some right good melons on the 'Pollock Strain of Rocky Ford Cantaloupe' vines, but, on the whole, I did not save any seed, as they were not netted enough or as good flavor to be good sellers." " 'Rust-Resisting Cantaloupe' healthy, no sign of rust or blight; fruit beginning to set; seed planted about the 1st of June." "No appearance of rust or blight as yet in 'Pollock Strain of Rocky Ford' melons; they are making fine growth, fruit beginning to set; am watching the test with much interest, for several years past blight has destroyed vines soon after fruit began to ripen." "I have gathered a crop of 'Rocky Ford' cantaloupes of fair quality, the vines commenced to blight before we had a ripe melon; the plants did not succumb entirely until most of the crop was harvested; the fruit was of good size and shape." "The condition of the 'Rust-Resisting' cantaloupe is very favorable at this date; no sign of blight has yet appeared with any of the varieties." "The 'Pollock Strain' is producing more sets for fruit than any of my other melons." "The 'Pollock Strain' cantaloupes are all blighted and not any fruit matured except where I sprayed them, there they have not shed a leaf where some other varieties, sprayed the same, have blighted considerably." "The 'Rust-Resisting Cantaloupes' that I am testing are in a healthy condition; no apparent improvement over the ordinary 'Rocky Fords.'" "The 'Pollock Strain' melons are in a healthy condition; no noticeable improvement over ordinary variety grown side by side." "The cantaloupe season is over and I find the 'Pollock Strain' no improvement over the kind I already have; however, the 'Rust-Resisting,' while a trifle later, are an improvement; vines stay green longer; I have saved all the seed to plant another year." "The vines seem to do better—the 'Rocky Ford'—and I wish to give a more satisfactory trial next season." "The 'Pollock Strain' do not show any signs of blight as yet, but the heavy rains washed the early blossoms off; they are looking fine now." "The vines of all citrons are looking well and at present can see no difference in our regular citron, 'Rust-Resisting' and 'Pollock Strain.'" "Rust first appeared on 'Pollock Strain' on August 10th; could see no difference the whole season between this strain and our regular cantaloupe." "On August 10th, when rust was first noticed on our regular cantaloupes, the 'Rust-Resisting' had two or three spotted, on August 24th not more than 10 per cent. as compared with 25 per cent. on the others, on August 31st about 20 per cent. and to-day (September 7th) about 25 per cent. to 30 per cent., while the others are practically gone." "The 'Rust-Resisting' cover an average of thirty square feet, show no signs of rust yet, though we have had a great deal of damp weather; they are rank color and hardy; the 'Pollock Strain' show some rust and are not a very good color." "The 'Rust-Resisting' cantaloupe were of an excellent flavor, vines keeping green long after citrons were done picking, large yield; the 'Pollock Strain' were an utter failure." "Regret to report that the wet weather and lack of sunshine completely destroyed my dozen hills of the 'Pollock Strain;' they only reached four inches in height; the 'Rust-Resisting' melons suffered the same fate though they were far in advance, when they simply rotted off at the stems at the surface of the ground." "Am testing the 'Pollock Strain' alongside several other varieties and can see no perceptible difference as yet." "I could see no material difference in the appearance of the vines of the 'Rust-Resisting' and the 'Pollock Strain' until about the middle of August, when the leaves of the latter turned brown and the fruit ripened nearly all at once. The 'Rust-Resisting' leaves were quite green and are not quite dead yet (September 10th); I picked the last of the fruit to-day; it is a poor quality and does not yield as well as the 'Pollock Strain,' which was of fine quality, but seemed to ripen prematurely; 'Emerald Gem,' planted alongside, about the same as the 'Pollock Strain.'" "The rabbits got the most of ours as fast as they came up, but what is standing does not seem to be blighting as much as our own variety; they do not seem to be set any heavier than our own; as yet we have not picked any, but the vines look strong and healthy; the 'Pollock Strain' are clear of rust and have a fine crop, doing better than my own seed in same soil." "Would say that some of the vines of the 'Pollock Strain' did not have any melons on them, while those that did were fair but not extra good; the vines have kept nice and green as also has the citron; the vines are still alive while we have finished picking them."

Rainfall of the Growing Season for Past Seventeen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	Average.
April	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.43	2.88	3.64	3.46
May	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	1.71	4.21	3.90
June	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.43	4.48	3.67
July	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	4.06	5.58	5.39
August	5.18	4.90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	5.72	5.95	4.22
September	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	5.23	2.19	3.91
Totals	36.87	25.75	21.16	20.85	24.67	24.79	18.83	21.72	30.31	25.16	22.14	20.36	32.16	26.57	28.01	25.43	23.03	26.05	24.55
Average	6.14	4.30	3.53	3.47	4.11	4.13	3.14	3.62	5.05	4.19	3.69	3.39	5.36	4.43	4.67	4.27	3.84	4.36	4.09
Rank in Wetness	1	7	15	16	11	10	18	14	3	9	13	17	2	5	4	8	12	6	......
Rank in Dryness	8	12	4	3	8	9	1	5	16	10	6	2	17	14	15	11	7	13	......

Temperature of the Growing Season for Past Seventeen Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	Average.
April...	51 2	50.4	52 0	49.3	49.2	50.3	49 1	52.4	5.04	47.8	49 9	50.8	48.3	50.2	50 9	46.7	49.9	51.2	49.4
May.......................	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65 3	60 6	58.5	61.1	60.9	58 6	60.3	62.7	62.8	61.4	61.0	60.9
June..........	69.9	70 7	69.7	72.4	69.7	70.6	71.7	68 1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	68.3	70.4	69.3
July.................................	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75 3	74.7	75 9	77.3	73 0	73 3	72.3	74.4	72.8	73.8
August..........................	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73 6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	71.1	74.6	72.2
September.............	64 8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64 4	69.9	66.8	64.6	65.0	64.8	65.4	68 9	66.1
Average................	65 2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64 3	64.0	64.3	65.1	66.5	65.3
Rank in Warmth	12	13	10	9	14	4	5	2	15	6	7	1	8	16	18	17	11	3	......
Rank in Coldness	7	6	9	10	5	15	14	17	4	13	12	18	11	3	1	2	8	16	......

Sunshine of the Growing Season for the Past Seventeen Years in Percentage of Clear-Partly-Cloudy Days.

	1889. Per cent.	1890. Per cent.	1891. Per cent.	1892. Per cent.	1893. Per cent.	1894. Per cent.	1895. Per cent.	1896. Per cent.	1897. Per cent.	1898. Per cent.	1899. Per cent.	1900. Per cent.	1901. Per cent.	1902. Per cent.	1903. Per cent.	1904. Per cent.	1905. Per cent.	1906. Per cent.	Average. Per cent.
April	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	77	83	66.7
May	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	74	77	67.3
June	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	77	73	72.9
July	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	81	81	72 6
August	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	74	68	74.0
September	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76	80	72.6
Average	61.5	73.5	72.2	78.2	73.3	74.7	78.2	75.2	80.0	72.7	79.3	78.9	69 5	76.3	72.7	77.7	76 5	77.0	71.0
Rank in Brightness	18	11	15	4	12	10	5	9	1	13	2	3	17	8	14	6	7	16	......
Rank in Darkness	1	8	4	15	7	9	14	10	18	6	17	16	2	11	5	13	12	3	......

WEATHER NOTES OF THE GROWING SEASON.

Herewith (page 511) is given a table of the New Jersey rainfall for the growing season—April to September, inclusive—for the past seventeen years. It is seen that for 1906 the precipitation has been an inch and a half above the average, and this excess was distributed over all the months, excepting September, which was quite dry, and the preceding month, rainy. The season, as regards moisture, was satisfactory, and upon the Gardens there was no time when irrigation was urgent.

The table upon page 512 shows that the temperature was above the average for all the months, excepting July. A glance at the "rank in warmth" line will show that the present season was third in high temperature, being exceeded only by 1896 and 1900. Combining the facts above stated, the season in question was hot and fairly moist.

The third table, upon page 513, shows that the growing season of 1906 was a dark one, being exceeded in cloudiness only by 1901 and 1889. In brief, the last season was moist, dark and hot.

There has been fully an average amount of plant diseases during the year. Early in the season there were many complaints of blight upon all orchard trees, that of the apple being especially in evidence. Among truck crops, the lima beans were perhaps the most to suffer from a mildew, appearing in August, and being particularly destructive in some localities.

The comparatively dry September proved very helpful to the potato growers, whose crop was prevented thereby from serious decay.

REPORT

OF THE

BOTANICAL DEPARTMENT

OF THE

New Jersey
Agricultural College Experiment Station

New Brunswick, N. J.

BY

BYRON D. HALSTED, Sc.D.

For the Year 1907.

TRENTON, N. J.
MacCrellish & Quigley, State Printers.
1908.

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REPORT OF THE BOTANIST.

Report of the Botanist.

BYRON D. HALSTED, SC.D.

EARLE J. OWEN, M.S., AND NAHUM D. SHORE, B.S.,* ASSISTANTS.

For the year ending November 30th, 1907, the Botanical Department has been working chiefly along the general line of the improvement of truck crops. The test includes sweet corn, tomatoes, eggplants, Lima beans, snap beans, summer squashes, winter squashes, peas, okra, onions and salsify, to which is added some ornamental plants.

The work with sweet corn has been much influenced by the very unusual season, particularly the first portion, when all early plantings were either destroyed or badly injured. The block of "Malamo" corn grown upon the Home Grounds was low in stature and small in crop; and the same terms characterize the block of "Malakosby." The later sorts, where the land was sufficiently rich, yielded fairly well, and some crosses were so satisfactory that seeds will be offered for trial to the truckers of the state. The cross that has been the most productive of all is the "Golden Bantam-Premier" (34/70). Last season the stalks often produced twin ears as Plate III. illustrates in the Report for that year. What with the plants strong, of good height and the ears frequently twins, of good shape and fine quality of kernels, this sort may prove acceptable for the second early crop. The "Adams-Crosby" cross has been carried forward another year, so that now the sweet corn has been separated from the flint (dent) grains of the "Adams." The plants have much of the sturdiness of the "Adams" with its fine plump ears and many straight rows of grains. This is worthy of a trial by those who wish a reliable sweet corn. The crosses of the "Golden Bantam" (an early yellow sweet corn) with the "Country Gentleman," "Stowell's Evergreen," and others are promising to combine the rich, long grains with an earlier maturing of the plant. A large part of the work with the corn crosses upon the "Smock Land" has been neutralized by the unfavorable season and soil, but in many instances seed enough was obtained to prevent the loss of a year in the progress of the experiments.

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* From June 15th.

With tomatoes, the work of the year has been mainly to make progress toward a fruit of marketable size, with a long axis and an interior made up largely of flesh with many small seed cavities. To this end those sorts with a large apple-shaped fruit have been bred with the "plum" and "pear" types of fruits, and it is a pleasure to record by means of a plate that a hopeful advance has been made. Among the two thousand plants upon the Home Grounds, there were some crosses so full of promise that seeds are to be offered for a trial by those who may desire to test them. Some of these are early, while others show merit as plants for the home garden. Some new types have come to light among tomatoes—one in particular combining the "Currant" and "Ponderosa" that is remarkable for both its shape and flavor. As usual, the freaks have not been slow in making their presence known—as, for example, a cross with the "peach" that is deeply ribbed like a squash, and of remarkably large size.

The eggplants did not make as large a growth of plant as usual, the cold, backward spring being unfavorable, but as the season drew to a close the showing of fruit was fine. A large number of crosses were grown, and of these "Long White" upon "New York Improved" (11/18) has given a satisfactory fruit in size, shape and color, and, under the name of "Ivory," its seed will be distributed. Further points of interest have developed among the hybrids between the "American" and "Chinese" species; by increasing the blood of the former the size of the hybrid fruits has been much enlarged, and thus hope is brightened that a combination of economic importance may be made. The way seems open for the production of a truly spineless eggplant.

The bush or snap beans have occupied much of the poorer land recently assigned to the Department, and some of the crosses are so far developed as to make it possible to offer seeds in the coming spring. Crosses of Lima beans have been given more than usual space. All of the leading sorts have been grown, and many crosses between them are upon trial. A study is being made of the "Willow-leaf" types as having a possible advantage over the ordinary sorts in times when the mildew is prevalent. Another generation of the hybrids between the snap beans and "Scarlet Runner" has been grown and the number of types are many, differing in form of vine, leaf, flower, pod and seed. The prolific plants may in some instances be the beginning of hopeful lines that are quite new.

Squashes of the summer sorts were given a place upon the Home Grounds, and out of the fifty and more selected inbred crosses of previous years, a few will be selected as worthy of a place among the commercial sorts. Several new kinds were grown and used extensively in the breeding. The winter squashes did not fare so well, they being assigned to the less fertile land where greater area was possible for them. Many of the crosses failed to mature fruit, but of others satisfactory results were obtained.

The crossing of garden peas, begun last year, was carried forward for a season, and some promising types are in evidence; in August a partial set of these was grown as an autumn crop, without considerable success.

Salsify, okra and onions all received some attention during the year. The Japanese Udo as a salad plant has not met the expectations, chiefly due to a blight that sickened the plants early in the season, from which they never recovered their full vigor.

During the year two bulletins, namely, No. 199, "Station Novelties in Truck Crops," (34 pages, 4 plates, 7 figures), and No. 202, "The Forest Trees of New Jersey" (54 pages, 25 text engravings), have been issued; the first dealing with the distribution of seeds, and the last gave some notes as to the range and culture of the trees of the state. The seed distribution last spring embraced 1087 packets as follows: Corn, 411; tomatoes, 330;

eggplants, 121; winter squashes, 128; "Pak-Choi," 47, and "Pe-Tsai," 50 packets respectively.

Some time has been consumed daily in the determination of the names and habits of plants, the examination of commercial seeds for impurities, the investigation of the diseases of crop plants, and the correspondence connected with the above and allied matters associated with the Department.

THE EXPERIMENT AREA.

The land devoted to plant improvement consists now of seven acres in three separate portions of the College Farm. The Home Grounds have been in charge of the Botanical Department for the past thirteen years, and consist of two acres divided into seven series, each of four plots, as shown by the plan upon page 264. Each plot consists of one-twentieth of an acre, and within the past year has been permanently marked by corner posts of cedar, thus making it an easy matter to arrange the several crops and keep the paths in place both ways of the area, as shown by the double lines in the diagram. There is an irregular piece of ground at each end of the rectangular block of plots and these are occupied with ornamental plants for breeding purposes and grass experiments.

The soil of the Home Grounds is fairly uniform in quality, it being a mixture of clay and gravel, and at the outset was not of the best for garden purposes, but its texture has been much improved by the annual application of manure at the rate of twenty tons per acre for the past thirteen years. These two acres occupy a gentle slope of land and water has been piped along the upper side to the head of each path and, from outlets there placed, irrigation is made easy for the whole area.

Another acre was added to the Experiment Area three years ago and consists of three equal strips, widely separated from each other in a neighboring field. Upon this area, called "The Strips," several of the isolated corn-breeding plots are located, and between them and filling up the strips crossed beans, peas and squashes have been grown. This land is a recent addition to the College Farm, and is not yet brought up to that richness and tilth demanded for the best results in plant-improvement experiments.

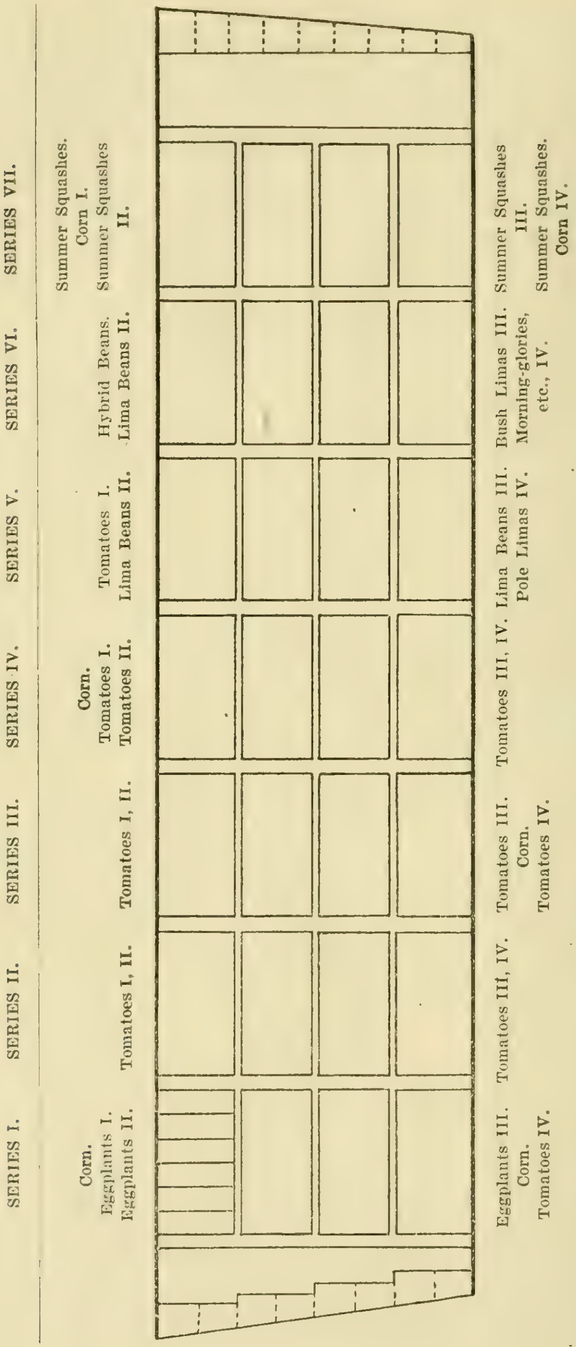
A third block of four acres of land has become available this year for the Department, through the gift of a tract to the College by Dr. J. C. Smock, for various purposes, one of which is forestry and nursery experiments. This "Smock Land" has made it possible to expand the field work, and when the soil, at present in a partially exhausted condition, is built up by green manuring and liberal fertilizing the foundation will be laid for much more extensive and satisfactory experiments along the lines of plant-improvement. Crimson clover, vetch and rye were sown in early autumn to be plowed under in the coming spring.

It is seen that the Breeding Grounds consist of three separated areas and one of these is further divided into strips with land between, devoted to farm crops. This distribution of the land is in large part necessary in order to carry out the experiments with crossed corn, and by means of this adjustment it is possible to grow upon seven acres not less than fifty-two blocks, exclusive of the breeding plot where new crosses are made.

This wide separation of the parts of the Breeding Grounds also permits of the isolation of the special crosses of other vegetables. Thus, a block of peas, beans, tomatoes, or eggplants, may be located a long distance from the general breeding plots and the chances for natural crossing thereby reduced, besides giving a test of the crop upon a more extensive scale.

In addition to the Breeding Grounds above described, the truckers and persons with home gardens only are invited to assist in the general testing of crosses of promise and in this way the experiment area is extended throughout the State and, in fact, the whole United States and beyond.

The Experiment Area for 1907.


SERIES I.
Corn.
Eggplants I.
Eggplants II.
Eggplants III.
Corn.
Tomatoes IV.
SERIES II.
Tomatoes I, II.
Tomatoes III, IV.
SERIES III.
Tomatoes I, II.
Tomatoes III.
Corn.
Tomatoes IV.
SERIES IV.
Corn.
Tomatoes I.
Tomatoes II.
Tomatoes III, IV.
SERIES V.
Tomatoes I.
Lima Beans II.
Lima Beans III.
Pole Limas IV.
SERIES VI.
Hybrid Beans.
Lima Beans II.
Bush Limas III.
Morning-glories, etc., IV.
SERIES VII.
Summer Squashes.
Corn I.
Summer Squashes II.
Summer Squashes III.
Summer Squashes.
Corn IV.
]

EXPERIMENTS WITH SWEET CORN.

Sweet corn in its many crosses was grown upon all three of the areas devoted to plant breeding. Such a crop, because of its wind pollination, precludes the planting of all the corns in a single block, and, in fact, it was on account of this subject in particular that the breeding ground consists of separate pieces of land. Upon the Home Grounds eight blocks of sweet corn were grown, and the times of planting, in connection with the nature of the crosses, were so adjusted that there was practically no cross pollination. In the first place, a block of "Malamo" was planted near one end of the long rectangle of two acres, and a block of the "Malakosby" near the other. The "Malamo" bloomed first, and there is no evidence of intermixing. Later on, at different intervals, the other six blocks were planted, the three upon one long side of the area with three crosses of "Golden Bantam," namely, with "Country Gentleman," "Premier" and "Stowell's Evergreen." These three blocks were all with yellow grains of the cross, while the three corresponding blocks upon the opposite side of the rectangle were planted with white grains of the above-named crosses. That these blocks produced almost absolutely pure white ears is sufficient evidence that mixing was practically absent.

"Malamo"—("Malakhov-Premo").

Like all the sweet corn grown this season, the stalks, crop, etc., were not up to the standard. The young plants were very slow in making their appearance, and for weeks afterward the sickly seedlings failed to grow. Even with all the discouraging conditions there were many good ears, enough to show that the variety was maintaining its previous record for a very early sweet corn, with a product sufficiently large to make it worthy of the attention of those who wish to grow superior quality table corn for home use. It is somewhat too small to be profitable for market in the present stage in the transition from any kind with large ears to that deserving the name of genuine sweet corn.

Reports from Testers of "Melamo."

"Stalk about four and a half feet high. The quality is all right." "Early but not very large, quality good for an early corn, averaged two ears to the stalk. Plant four to four and a half feet high, rapid and thrifty grower. Planted the 25th of May, picked first corn last week in July, which is very good considering the lot of cold weather we had." "Very early, good flavor." "Planted the same day as 'Minnesota' in adjoining row; the 'Malamo' is much the stronger grower, and apparently more productive. Certainly a fine corn; I find it a fine grower." "Eared well, quality good." "The best eating corn I ever tasted; grows mostly two ears to a stalk; the suckered corn does not have so many ears, but is nicer." "Corn was fine, will say that it is the earliest and sweetest corn I ever raised, had fine table ears in sixty-six days." "I had first corn yesterday; it was fine, nice deep grains well formed, small stalks, ears six inches long." "'Malamo' is doing well, have had several messes from it and quality is excellent." "Ears solid, sweet, sound, perfect, two on each plant; a few have their length, five and a half inches. A good vigorous early sweet corn, and very desirable." "Sweet, free habit, ears borne at bottom of stalk." "Quality is very good for so early a variety. It is about a week earlier than my best early corn which I have been growing for four or five years." "This corn was a success, it matured in seventy-eight days. The stalks were very short and the ears of good size and well filled and of good flavor." "This is an early sweet corn, is four to four and a half feet high, the ear was well filled. Grains perfect size, seven to eight inches long." "The sample of sweet corn received was very sweet and tender, the ears mostly perfect." "Came up very well with strong stalks and large ears." "Season early, stalks short, ears medium, quite a number two ears to one stalk; grains plump and ears filled to the tip with kernels. I consider it a great improvement over the 'Cory.'" "We have used some of the 'Malamo,' and the quality seems to be good, the ears are about six inches long and most of them have about twelve rows." "Grain firm, sweet, full and very meaty." "Strong growing, good-sized ears, often two on stalk, improvement on 'Golden Bantam,' as it is larger and stronger growing; improvement on 'Country Gentleman,' as it is better quality. I consider 'Golden Bantam' best quality sweet corn, but this cross seems to be as good with larger better ears and not much later." "Germinated extra well, plant medium size, gathered for table use early in

July." "Nine hills were planted about forty inches each way on April 26th. This corn was in the roasting stage July 22d. Three to four ears were harvested from each hill, the picking being continued until August 7th. The flavor was excellent." "This corn is of a very fine quality and very sweet." "I find the 'Malamo' sweet corn grown from the seed sent me to be of good flavor. Large meaty grain well filled to end of ear, the ears are not large, the plant matured in a short time and was of medium height. I should consider it a good variety for an early corn." "Corn very sweet." "Very early variety." "Planted May 22d. Had our first corn July 30th. Plants about five feet in height. Ears six to seven inches long. The quality extra sweet for an early corn, as sweet as most of the later sorts." "Plants of good size, six to seven feet, vigorous, productive, one to two ears, ears of good size, regular, six to eight inches long, well filled, quality good." "Good quality for so early, find it a few days earlier than 'Golden Bantam.'" "Earlier than the 'Burlington White' corn and sweeter. Stalks from three to six feet high. Ears small." "Very early, sweet." "Quality good; I am well pleased with it and will save all I can for seed." "The corn was deliciously sweet, could not have been better. The ears were very small, as were also the kernels. The soil here is very sandy and dry. I felt very proud of the corn." "Grains exceptionally plump, giving ears better appearance after husking than before." "Quality excellent." "It is sweet and rich in flavor. I am satisfied, if properly grown on rich soil, it would be a most excellent early sweet corn." "Plants very strong and vigorous, very handsome shaped ears, quality of grain fine, it is the best sweet corn I ever saw." "Size of plant six feet; large ears, grains of a good size and flavor." "It made a good growth and the ears were of good size; in these respects, it was a great improvement over the Russian parent, which I grew last year." "I like the size of the grains, they are plump and well formed." "The earliest of all our varieties to mature." "Matured early; stalks about five feet high." "Fair-sized stalks bearing very sweet, medium-sized ears." "Plant rather small; ear large for size of stalk, quality of corn excellent."

"Malakosby"—("Malakhov-Crosby.)

As in the previous year, the "Malakosby" was somewhat later than the "Malamo," with the compensating advantage of being larger. The two kinds are easily distinguished while growing and, in fact, the differences in the field are greater than that between the ears and grain. The "Malakosby" may prove to be a good sort to plant at the same time as the "Malamo," to follow it in the sequence of the harvest of ears for the table.

Reports from Testers of "Malakosby."

"Every kernel planted of this corn germinated, and the plants were very vigorous." "Most of the stalks of the corn, which I planted early in pots, have given me two good ears each. The quality is good." "The quality of this corn is all right." "Very good ears." "Corn is very sweet and tender." "Kernel sweet and skin tender." "Corn sweet, a fine extra early variety." "I am much obliged for the corn, as it was fine. It was nice and sweet and the kernels were large." "Quality of grains decidedly good." "Grains fine, very sweet and full." "Quality good." "An excellent variety almost as early as 'Sunrise' and ears uniform, large and very white." "The quality of 'Malakosby' was excellent." "We have used the corn on table and find it sweet and of good flavor." "Corn of good quality." "Most of the grain of the corn was uniform. The grains were very sweet. This corn is excellent for the table." "Quite early." "Very fine corn and sweet." "Grains large, quality excellent." "I consider this sweet corn very hardy because every hill came up when other sweet corn had to be entirely replanted, having started to plant on May 16th when weather was very unfavorable being too wet and cold. Some ears were ready by August 1st to use for table, and proved to be of very fine flavor and well shaped. The corn stalks are about five to six feet high, earing about eighteen inches from ground and yielding one or two good ears to stalk. Am very pleased to have some of this sweet corn in my possession and intend to plant it for my early corn." "Germination was excellent and appearance is now good." "The sweet corn you sent me this year is very much nicer than last. The ears are much larger and the corn sweeter, and it was as early as the other." "Quality excellent, equal it seems to me to that of the 'Black Mexican,' but the grain is rather shallow. Very early, ready to use fully as soon as 'Black Mexican,' planted three weeks earlier than 'Malakosby.'" "The best early corn I ever planted, stalks small, ears fair size, grain large and deep, extremely small cob. Corn very sweet and fine flavor." "This sweet corn was very early, ready for use even this backward year, July 15th; the stalks were strong, thrifty, although very dwarf, the ears large for size of stalk and of good quality." "It is a good variety; early but small, short ears. It is sweet and productive, medium size grains." "Plant very small, ear medium, very productive; flavor good and very early."

The Study of Color in "Malakosby" Grains.

The "Malakosby" sweet corn has two quite distinct shades of color to the ears, the one a "straw" and the other has been spoken of as "pinkish." These two shades are not grain characteristics, for the two are not mixed in the same ear; in other words, the ear is either "straw" or "pink," and the cob partakes of the latter qualities respectively. This peculiarity of two shades of ears is equally present in the "Malamo," which, it is presumed, also obtained it from the same source.

As seed was needed of the "Malakosby" for further distribution, grains from the "pinkish" ears only were planted in a block, and the following is the result of the three gatherings of the ears:

September 10th,	14	"straw"	7	"pinkish"
" 27th,	14	"	4	"
October 7th,	61	"	30	"
Total,	89	"	41	"

It is seen that the "straw" ears were two to one of the "pinkish." This test shows that the two colors are not easily separated. It is desired that a trial be made of growing a block of this corn from the straw-colored grains.

"Golden Bantam-Country Gentleman" Cross (34/19).

The plantings of the above cross were made in two plots, widely separated, the one with yellow and the other with white grains, both from four zigzag ears. Furthermore, the two plots were divided into halves, the one half (sixteen hills) being planted with long grains and the second half alongside with broad grains. As early as August 16th, it was noted that the plants in two rows from long grains were taller than those in the adjoining two rows from broad grains, suggesting a possible correlation between length of grain and stalk. At the time of full growth the difference was one foot, on an average, in favor of the plants from the long grains. Those from the broad grains matured earlier, and ripe ears were first gathered from these two rows upon September 4th, or one hundred and eight days from time of planting. Upon the 25th the ears were gathered for the photograph* as shown in Plate I. The five ears in the upper left hand corner represent the crop from the long yellow grains, ears 1 and 2 and 4 and 5 being twins, respectively, while the one at 3 gives an idea of the type of ear borne singly. In like manner the set of five ears, 6 to 10, shows two pairs and a single (8) from the broad grains.

A careful inspection of the whole crop does not lead to any conclusion as to the influence of the shape of the seed grains upon the progeny in a cross. A much more extended experiment is needed, but there is some indication that a broad grain may produce shorter and earlier plants than the long grains from the same cross.

By an oversight in harvesting, the ears of all four rows were gathered together so that the relation between the shape of grains and number of straight-rowed and zigzag ears was not obtained. There were one hundred and thirty-five good-sized ears harvested from the thirty-two hills, which was a small yield, but fair as sweet corns turned out the present season. Of the number named, eighteen were distinctly zigzag and eighteen straight-rowed, or practically one-eighth of the whole number were of the types of the two parents.

The lower half of the plate shows sample ears from the plot planted with white seed of the cross in question. From 11 to 15 are two pairs of twins, and a single between them (13) representing the two rows planted with long grains, while from 16 to 20 are five ears, the first two twins and the last three triples from the rows planted with broad grains. As in the case of the previous plot planted with yellow grains, the broad grains pro-

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*All photographs used in this Report were made by Mr. F. H. Dodge, to whom many thanks are due for his painstaking skill.

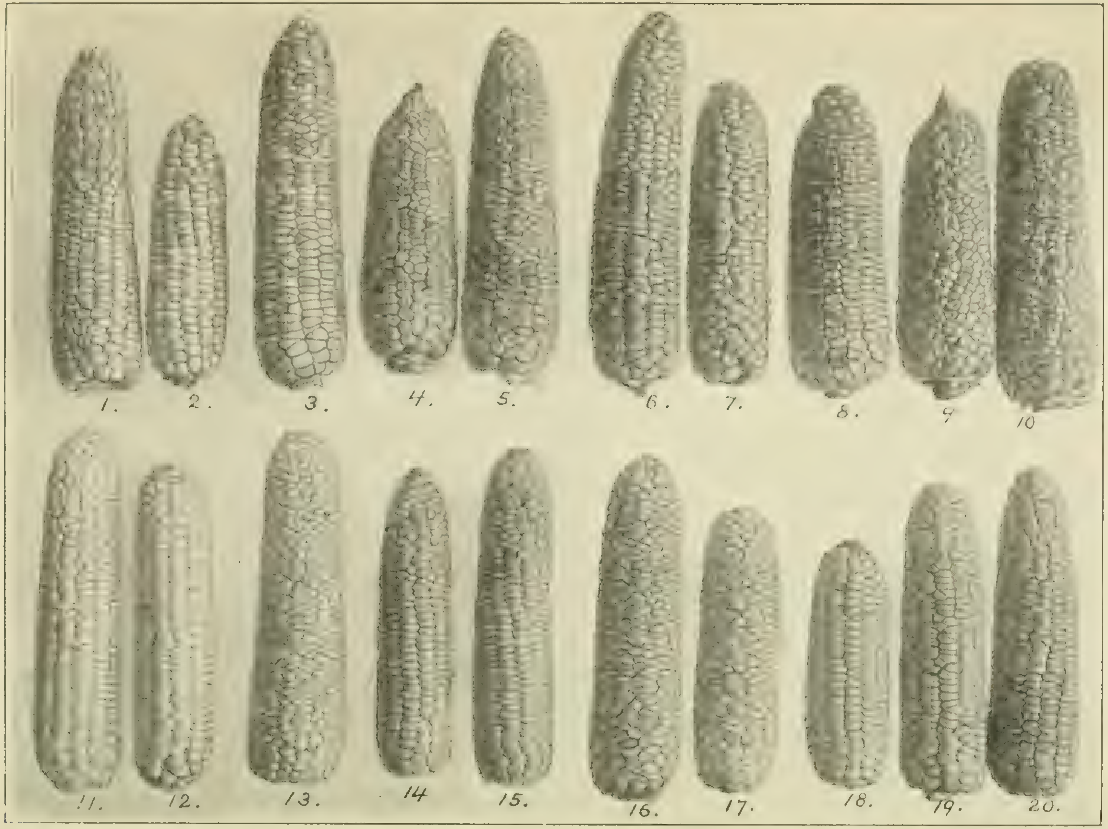
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Plate I. *"Golden Bantam-Country Gentleman" Cross.* Ears in upper rows (1-10) from yellow seed and all twins, excepting 3 and 8; ears in lower row (11-20) from white grains, all twins excepting 13 and 18, 19 and 20, which three are from one stalk.

duced shorter plants, very uniformly so, and noticeable to any ordinary observer, that were somewhat earlier in coming to table maturity. Concerning the effect of the form of the seed grain upon that of the crop, it may be written that nothing definite was observed. The harvest of the two sets of plants was made separately with the following results: Long grain seed had 13 ears zigzag, 15 ears straight-rowed, and 15 ears mixed, making a total of 43; broad grain seed had 9 ears zigzag, 21 ears straight rowed and 7 ears mixed, making a total of 37.

The long grains gave the better yield of ears, and had a larger percentage of the zigzag type, especially when it is understood that the "mixed" group included any ears that had departed from the straight-rowed. When the two lots are combined, the results are: Zigzag, 22; straight-rowed, 36; mixed, 22; which show that when the seed is from zigzag ears the output of straight-rows is nearly fifty percentum.

The "Golden Bantam-Premier" Cross (34/71).

The above cross gave one of the best crops of all the sweet corns. A block of thirty-two hills was planted upon Plot 1, Series IV., May 18th, the seed being yellow grains from four ears (two twins) twelve to fourteen-rowed. The stalks were stout and of medium height, and bore ears of table maturity August 20th. As seen in the field the ears are long and somewhat slender-pointed, and there is no exposure of the tips of the ears as they mature. The form of the ear is well shown in Plate II., where in the upper half six pairs of twins are shown, those with eight rows of grains being placed to the left. While the seed was all from ears of twelve or fourteen-rowed, a majority of the crop was made up of eigth-rowed ears showing the strong tendency of this cross to keep to the number that prevails in the male parent and frequently met with in the "Premier." For a medium-early sweet corn the three pairs of ears shown at the right hand of the set of twelve under consideration are worthy of remark, and from these it is hoped to select for a further improvement of the type of ear. It may be possible to increase the number of rows and, at the same time, gain an ear that is cylindrical and not eight-rowed and taper-pointed.

In this block there were 166 ears of suitable size for seed-saving and many small ones, some of which were the third upon the stalk. A photograph was secured of six sets of triplets when all the ears were large enough for the table. Whether these grains are the best for planting is a matter of conjecture, but some uncertainty will be removed by the ear test for vitality and strength of germ that is made during the winter season. Of the whole number of ears saved fifty-two were solid yellow—the first and the fifth pair counting from the left being among them, showing that there was no adherence to the "Golden Bantam" type when the color agreed with it; in other words, one character, like color, is not necessarily correlated with another. The mixed ears numbered one hundred and four, which happens to be just double those with solid yellow—an instance agreeing perfectly with the expectation under the Mendelian law. After the excluding of the white grains from the parent ears there were one-third pure yellow grains and two-thirds of mixed blood, but with the yellow present and prohibiting the separation of the two lots. As before pointed out, the yellow strain of any cross between a yellow and a white sort will constantly show white grains, but in uniformly diminishing numbers, provided that the white grains are always rejected before planting.

On the other hand, the white strain (because carrying no yellow) is separated, at once and finally, from the ears of the blend plants, provided only that the crop therefrom is successively grown under isolation. In the present instance the two blocks of the cross in question were grown upon the Home Grounds. and the nearest hills were about one hundred feet apart. There were not more than twenty grains of the yellow upon the 155 white ears that were gathered for seed. In the set of six pairs of these ears shown in the lower half of Plate II. there was but a single yellow grain, and it may be seen in the upper half of the leftmost ear. It is not advocated to have less than fifty yards between two blocks of breeding corn, and much more is better, but in the present instance the mixing was but the slightest, and is permissible for the yellow marks itself, and such grains are easily excluded,

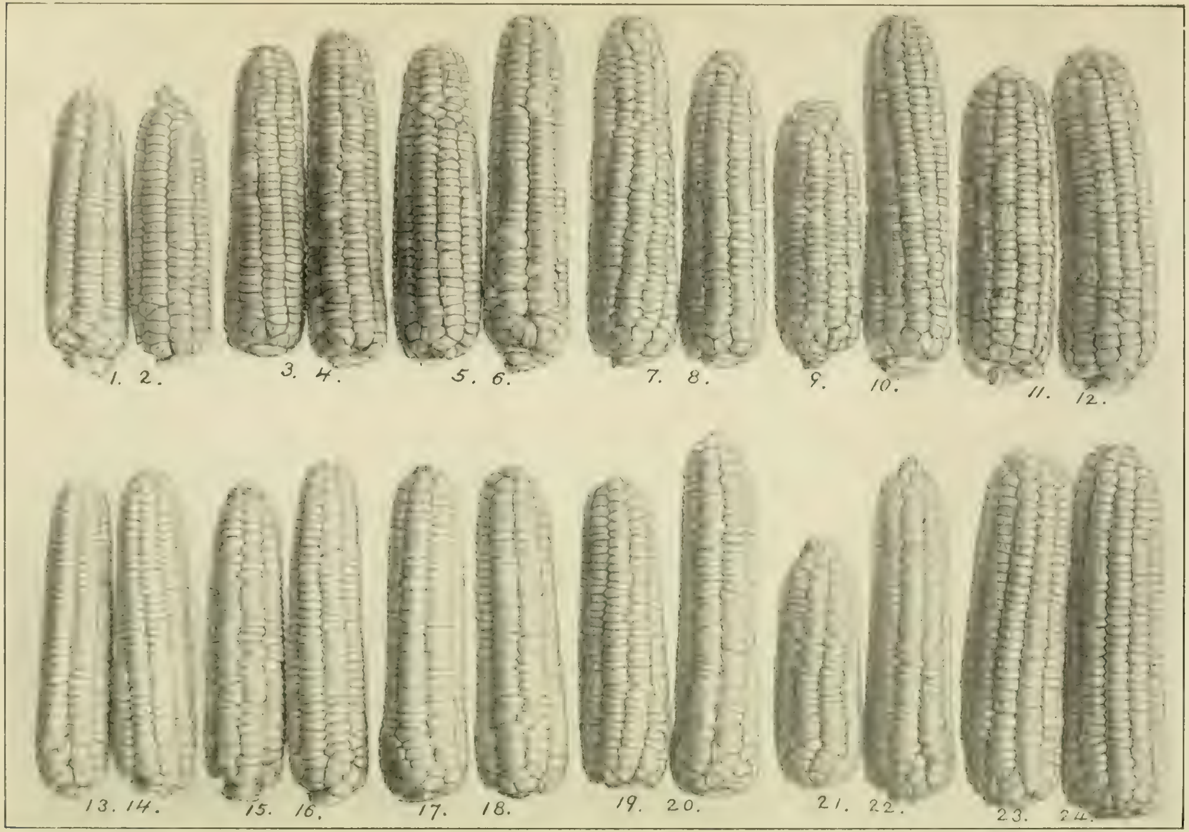
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PLATE II. *"Golden Bantam-Premier" Cross.* Ears in upper row (1-12) from yellow grains, each pair being from same stalk; ears in lower row (13-24) from white grains and represent six pairs of twins.

and, as for the white upon the yellow, it is the same cross and does not add any vitiating element.

The white ears were practically the same as the mixed in number, there being, perhaps, more of the triplets among them—but they are not quite as large as the mixed ears, a difference, however, that may be accounted for in soil conditions, for the block of white corn was upon lower ground, and the plants suffered much more during the long, cold, damp spring.

Seed of the two strains, namely, (1) the yellow and (2) the white, will be offered for distribution provided only that the set standard for the germination test of the ears is met.

Reports from Testers of the "Golden Bantam-Premier."

"Ears seven inches long, with good-sized kernels; superior to 'Burpee's Golden Bantam.'" "Corn very sweet; grew quicker than the 'Bantam' itself." "Planted May 23d, eaten August 17th, stalks six to seven feet high, two ears to a stalk, good-sized ears. Grains same size as 'Golden Bantam;' a few white grains. Quality as good as 'Golden Bantam,' and it will be of great use if it will breed true to type." "Quality good." "Very sweet." "Eighty-eight days from planting I gathered the first mess from this corn. I pronounce it an excellent variety." "Plant strong grower, ears medium, quality of grain good, very nice cropper." "It did well, two ears to a stalk, ears large size, first ears to eat August 15th. Very sweet." "The sweet corn is of fine quality." "The corn is delicious; it is hardy and productive." "Corn was excellent, very sweet, medium-sized ears; as good corn as I ever tasted, and so said all who ate it." "An excellent variety; ears medium to large, well filled. Deep, large kernels, cob small. Quality closely approaches 'Golden Bantam' both in texture and flavor; a few ears seemed to be sweeter than 'Golden Bantam.'"

The "Golden Bantam-Stowell's Evergreen" Cross (34/83).

Selected yellow grains from two pairs of twins were planted in thirty-two hills in Plot 1, Series VII., rather late in the season (May 18th) on account of the unusually backward season. This plot made the heaviest stand of plants upon the Home Grounds, largely on account of the late planting. Upon August 17th the plants were past bloom, and upon the 29th (103 days) the ears were tested upon the table, they being of fine size and shape and of superior quality. The harvest was made at several dates, the ears being kept in separate lots. A violent rain and windstorm prostrated the plot of plants, which interfered somewhat with the study of the plants during the last weeks of their season.

In the upper half of Plate III. is shown a dozen ears of the cross in question, all of them pairs of twins. The first pair upon the left and the next to the last to the right are solid yellow, while the others represent the main crop of mixed ears, the yellow outnumbering the white grains three to one. The ears, as may be seen from the samples, follow the "Stowell" parent to a large degree and are, therefore, not small and slender and eight-rowed like the "Golden Bantam." For ordinary purposes the ears are large enough, of a desirable cylindrical shape and, when grown singly, are well filled out to the end. Without any intention of showing this feature, it is to be seen that usually one of each pair—the older to the right—has the good characteristic here in mind. The grains are not as long as the "Stowell," but it was expected to lose somewhat in this respect in getting an earlier corn. When the cross under consideration is improved by selection there is much hope of getting a medium crop, large-eared, high quality sweet corn, and it may be either yellow or white, as the grower chooses, for out of the same cross, both colors are produced. In case of the yellow, there will be some white grains lingering unless close breeding within the plant is resorted to, when a possible weakness may result. There is a large field for experimentation here in the fixing of qualities, making the crosses absolutely uniform and, at the same time, keeping them up to the desired standard of vitality and fruitfulness.

In the lower half of the plate is shown a set of six pairs of twins from the plot planted with the white grains of the "Bantam-Stowell" cross, and not a single yellow grain was found in the whole lot, which shows that the white grains do not hold latent any yellow color. This plot was planted early and was out of bloom before the later block of the same cross, but from yellow seed, was in flower. In fact, it was planted too early, and many

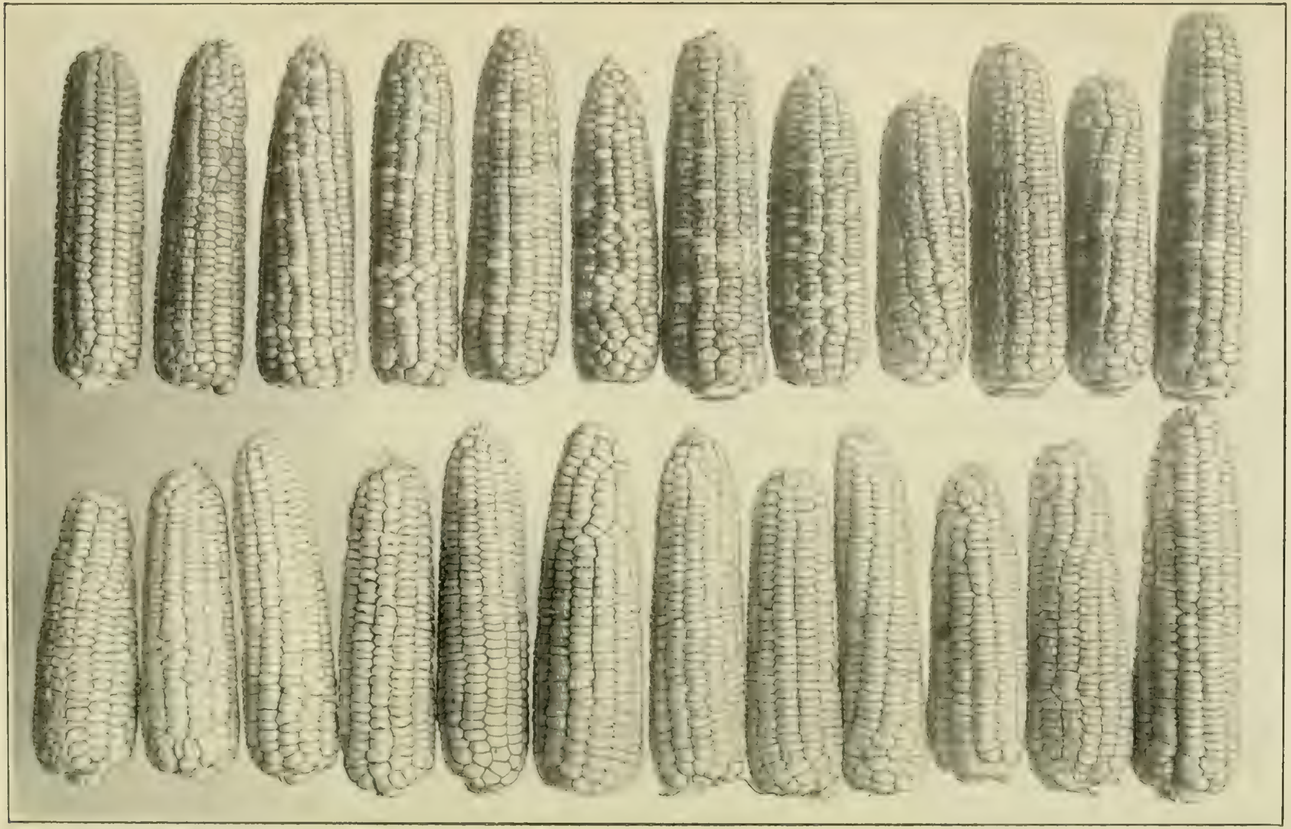

PLATE III. *"Golden Bantam-Stowell's Evergreen" Cross.* Ears in upper row (1-12) from yellow grains, each pair being from same stalk; ears in lower row (13-24) from white grains and represent six pairs of twins.

of the grains failed to germinate in the cold, wet soil, and the crop was decidedly inferior to the later lot. This is easily seen from the samples shown in the plate. If the yellow seed had been planted in place of the white, and *vice versa,* the results, probably, would have been in favor of the white, for it is not likekly that there is a correlaton between the color of the grain and any hardiness of the kernel or plant issuing therefrom. The flint or wrinkled nature of the grain is quite a different matter, as in this instance the hardiness of the grain withstands unfavorable conditions far better than the soft, sweet grain, and the former may live through a cold, wet period after planting, when the wrinkled ones would rot. It is on this account that such early table sorts as the "Adams" are planted as a first crop.

Corn Upon the "Strips."

As before stated, the Department has an acre of land in three long strips that extend across a large field. At the ends and across the middle of each of these strips, plots of corn are planted for isolation; first, nine early maturing sets, and close by these nine plots shortly after, as many later maturing crosses are planted, thus giving isolation more or less complete to eighteen small plots of corn.

The "Adams-Crosby" Cross (2/20).

From blend ears that last season bore three-fourths flint and one-quarter sweet grains, the former were selected and planted May 8th in Plot 1 upon the "Strip." Considering the backward season, this plot of sixty (4x15) hills made a good growth that in no small part was due to the flinty nature of the grains that are thereby able to resist the cold and wet of the prolonged bad spring weather. The first harvest of ripe ears was made upon August 31st, or one hundred and five days from planting. It was noted in the record that these early ears were very closely of the "Adams" type. Upon September 11th, nine other ears were ripe and secured, and these also were nearly all solid dent. At the first harvest only the best ears were selected for study and record, and of these the entirely flint ones numbered fifty-six, and the mixed one hundred and six, that is, practically one-third were solid flint and two-thirds were mixed—samples of the former being shown at the upper left hand corner of Plate IV, and the latter to their right. A count was made of the flints and sweets upon ten of the mixed ears with the following result: Flint, 3427, sweet, 744, which is a much smaller percentage of sweet grains than expected under the Mendelian law.

As a rule, the mixed ears were of a more desirable shape and size than the flint ones, as may be determined from the six samples shown in the plate. It seems to be true that the sweet grains interspersed upon the mixed ears are as thoroughly wrinkled and free from the starchy nature of the flint as those from ears where all the grains are sweet. At first sight, the origin of the flintiness, often noticeable in sweet corn, does not appear to be due to admixture of the "blood" of a flint corn by a recent cross.

Plot 2 was occupied with a set of plants grown from the sweet grains selected from the same ears that furnished the seed for the plot last considered. The plants of this set, sample ears of which are shown in the lower row of Plate IV, were somewhat smaller than those for the flint grains of the cross in question, but this is probably as expected, the grains and seedlings therefrom being more influenced by the cold, damp spring weather. The ears, as a rule, are less well filled out at the tips than the mates in Plot 1; other than this the ears are desirable in general shape, but need much selection to develop a uniformity in the number and directness of the rows . The set contains purposely some ears from the early harvest, which are dried out and the grains shriveled, while the others are nearly freshly picked. A large majority of the ears are solid sweet, but two in the engraving show a few flint grains that, it is presumed, came from Plot 1. As both plots are of the same cross, they might have been grown side by side and no harm from mixing of varieties would have come. In other words, the flint grains are all "Adams-Crosby" cross, as likewise the sweets wherever found in the two plots.

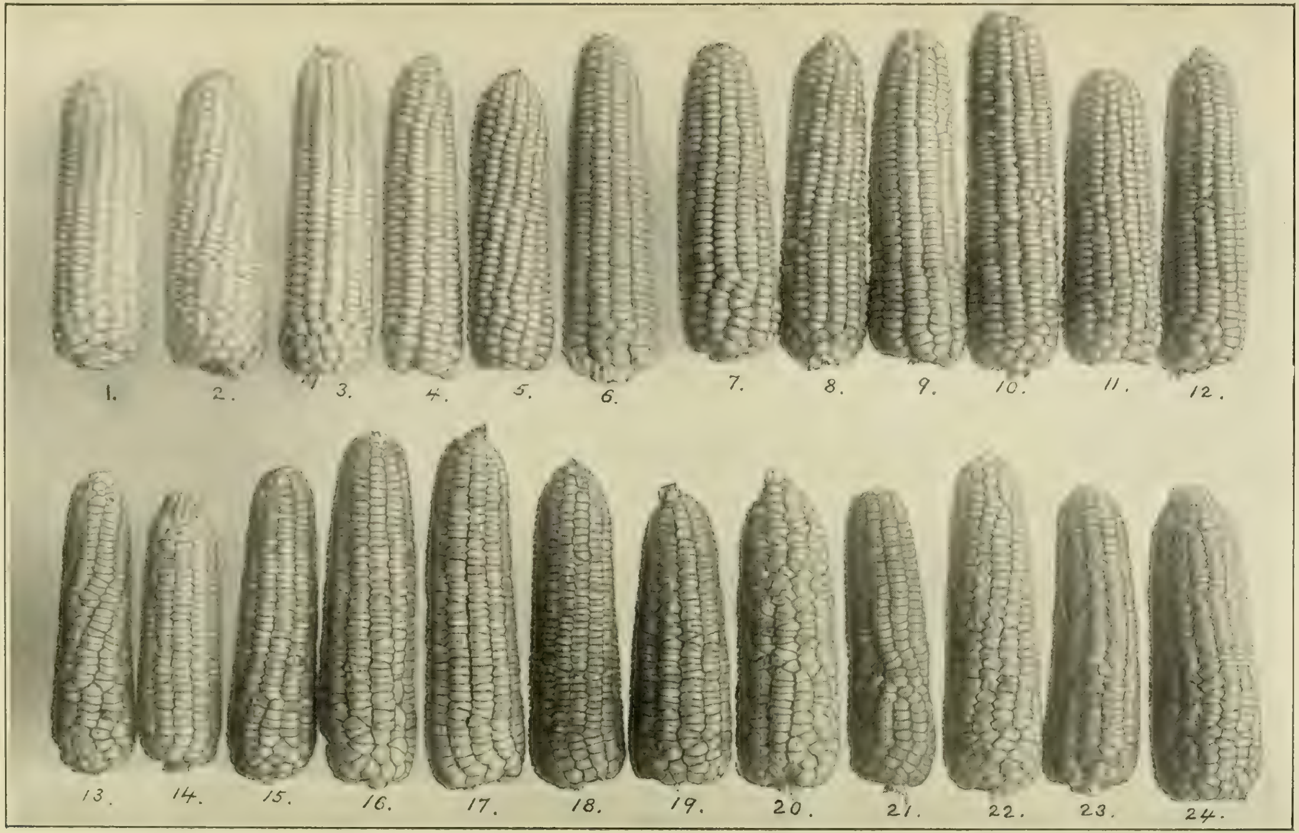
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PLATE IV. *"Adams-Crosby" Cross.* Ears from 1 to 6 show types of solid flint, from 7 to 12 with a small amount of wrinkled kernels, and the lower row, ears of the sweet kind, some of which were photographed green and others dried.

Reports from Testers of "Adams-Crosby" Cross.

"Planted April 17th, cut it August 1st. Stalks about six feet high. The ears are about half as large again as 'Malamo' and 'Malakosby.' The quality is all right." "Quality of the very best." "Stalks about seven feet high, vigorous, medium-sized ears, large grains, sweet and tender, a desirable garden corn." "Quality excellent, sweet and tender, very juicy. Altogether a valuable corn." "Corn averaged six and a half feet tall. Strong grower. Ear large in the round, and from six to ten inches long. Kernels nearly all in straight rows lengthwise of the ear. Generally one ear to stalk. Quality of grain considered very fine, was sweet and tender." "Four to five feet high, small ear, quality very good." "Some ears were very large and with deep kernels of fair quality, others with short kernels and large cobs. Usually two ears to the stalk, few suckers."

"Golden Bantam-Banana" Cross (34/6).

The three plots of Strip II, that is, Nos. 4, 5 and 6, were planted with the "Golden Bantam-Banana" cross. In Plot 4 yellow grains from zigzag ears were used, and gave a superior block of corn, considering the unfavorable season. Upon September 10th the earliest mature ears were gathered, one-quarter of which were zigzag. The total of all the ears of suitable size for seed was one hundred and thirty-five, twenty-eight of which were straight-rowed. There were no pure yellow ears, but all were with a quarter of white grains. The record states that there were none of the pure zigzag type, but one hundred and seven had the grains more or less out of line.

This block of corn was superior in yield and size and form of ear to the "Bantam-Gentleman" cross, previously considered as grown upon the Home Grounds, but otherwise they resemble each other, and no plate is needed to show the "Banana" cross.

In Plot 5 yellow grains from straight-rowed ears of the above cross were planted. This block chanced to be upon a very poor spot of ground, and the crop was small and consequently inferior to the block last mentioned. The first harvest of ears was made upon August 29th, showing that the cross was more rapid here in ripening, which may have been due to the drier locality. Only thirty-six ears of marketable size were secured, all of which were staight-rowed excepting two, which were somewhat zigzag. The grains were three-fourths yellow upon the ears generally, but with four the kernels were all yellow, that is, one ear in nine of the whole crop was solid yellow.

Plot 6 was planted with white grains from straight-rowed ears of the above cross, and, here again, the yield was so small as to interfere with the results that it was hoped to secure. There were twenty-three ears of fair size, all of which were pure white but one, and straight-rowed with three exceptions, in which there were strong signs of the zigzag type.

The three plots with the "Golden Bantam-Banana" cross as a whole gave much hope of securing an acceptable (1) medium early, yellow zigzag, and (2) straight-rowed strain, and from the white grains a corresponding pair of strains, namely, (3) zigzag and (4) straight-rowed with the yellow of the "Golden Bantam" omitted. The three blocks show that seed from zigzag ears is quite apt to reproduce its type, and the same is true of the grains from the straight-rowed ears.

Reports from Testers of "Golden Bantam-Banana" Cross.

"I find this a very good and early corn, the stalks are about five feet high, nearly every one has two ears to a stalk, the ears are about eight inches in length; I planted some 'Evergreen' the same day, and it was thirty days later. I consider it a first-class early corn." "This sweet corn is large, tender and very sweet, height of plant about six feet high, corn is very fine." "The corn made a vigorous growth. Stalks were two-fifths of the 'Bantam' type, and the rest were tall. Ears were six and seven inches long. The grain was short, with a hard skin, but sweet." "The plant is six feet high, the ears are very fine, seven inches long, and the grain is uniform, very juicy, well filled and large. I prefer it to any other." "Was very nice, so sweet and fine flavor." "Corn was of excellent quality." "The best of the 'Golden Bantam' crosses. Medium sized ears, well filled, with deep kernels. Quality good."

A Test with Flinty Seed.

The "Malamo" sweet corn has shown a tendency to develop some starch in the grains at the expense of the tissue that abounds in sugar. Such grains are easily seen while they are upon the cob, as they wrinkle less than the others and the starch-bearing interior shows through, giving a lighter appearance to the grains. These kernels have been termed "flinty," in distinction from the pure flints upon one side and the "sweets" upon the other. It is not presumed that the flintiness in question is due to any immediate influence of pollen from any flint corn that may chance to have reached the young sweet ear. When this last event happens, so far as the writer knows, the grain is a flint comparable with the male parent in the accidental cross.

The flintiness in question is usually only partial, and if a large number of varieties of sweet corn are examined it will be found to range from an almost indistinguishable amount to that where the grain is not easily separated from those that are unmistakeably pure flints. The great bulk of the grains showing flintiness are, however, wrinkled and show one mass of no great size that is starchy. An examination of the most truly sweet grains shows that there is some starch present, and it is by an increase of this that the flinty grain is produced. Whether there are any sweet corn grains that have no starch in their interior remains to be demonstrated, but it is assumed that any large amount is not a desirable feature, as it allies such grains to the starchy sorts that are not table corns in any true sense.

A field test was made the present season concerning the power flinty sweet corn has of reproducing its kind. A block of sixty hills (Plot 9) of "Malamo" was planted with grains showing flintiness, and at the same time, a similar block (Plot 8) was planted with grains of the ordinary type. The season was so unfavorable that the crop was small upon both blocks, and in this regard the two plots were served alike, but it is apparent that the unfavorableness for a good crop may have a tendency to develop the flintiness. From the crop of each plot twelve ears were selected that showed the most of the flintiness, and are given in

Plate V. There were a few ears from the block planted with ordinary sweet grains that showed a flintiness, and these are arranged to the left in the upper row, that is, the ears are placed with the ones showing most strach-bearing grains to the left. The set of twelve ears from the block planted with flinty grains, given in the lower row, all show the starchy kernels in great numbers, and no attempt was made to arrange them upon the basis of flintiness.

This test, so far as it goes, shows that flinty grains tend to reproduce their kind, and suggests the natural opinon that all ears of sweet corn that show starchy grains should be rejected.

It is not the purpose here to enter into any philosophical consideration of the subject, either as to the origin of the flintiness or its value in the economy of the plant. It may be a tendency to revert to the original type which was starchy, the influence of some previous breeding with a flint sort, a way that the sweet corn has to compete with unfavorable conditions that the suffering mother hands down to the offspring, etc. Whatever the cause or combination of causal conditions, the practical fact is that the highest type of sweet corn is not considered as having flinty grains, and all such may well be rejected at planting time.

"Voorhees Red" Selection.

The only plot in the "Strip" not previously described (No. 7) was occupied with forty-five hills of the "Voorhees Red" sweet corn, planted from a single twelve-rowed ear. The crop shows some variation in the plants and ears, and an occasional white grain was present, as naturally expected from the nature of the original cross ("Black Mexican" upon "Egyptian"). From the plot some of the best twin and single ears, all solid red, were saved from plants previously labeled for their good qualities, and the work of further selection will be continued.

Second Set of Plantings upon the "Strips."

Upon June 20th a second set of plantings was made upon the "Strips," the blocks containing twenty-five (5 x 5) hills adjoining the plots that were planted May 8–10th. The whole nine blocks

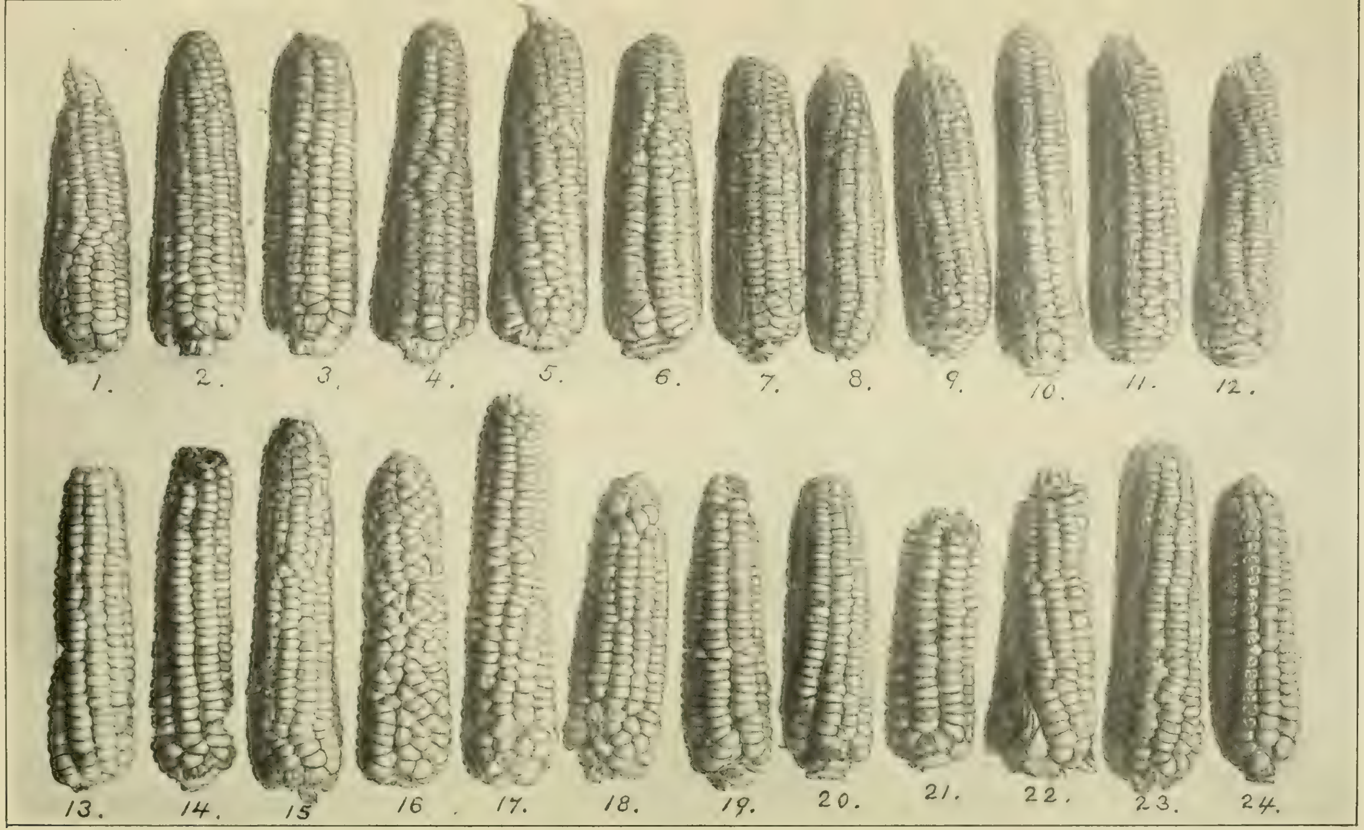
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PLATE V. *Test for Flintiness in Sweet Corn.* Ears in upper row (1-12) are of "Malamo" under ordinary culture; lower row (13-24) shows ears of same variety grown from selected flinty grains.

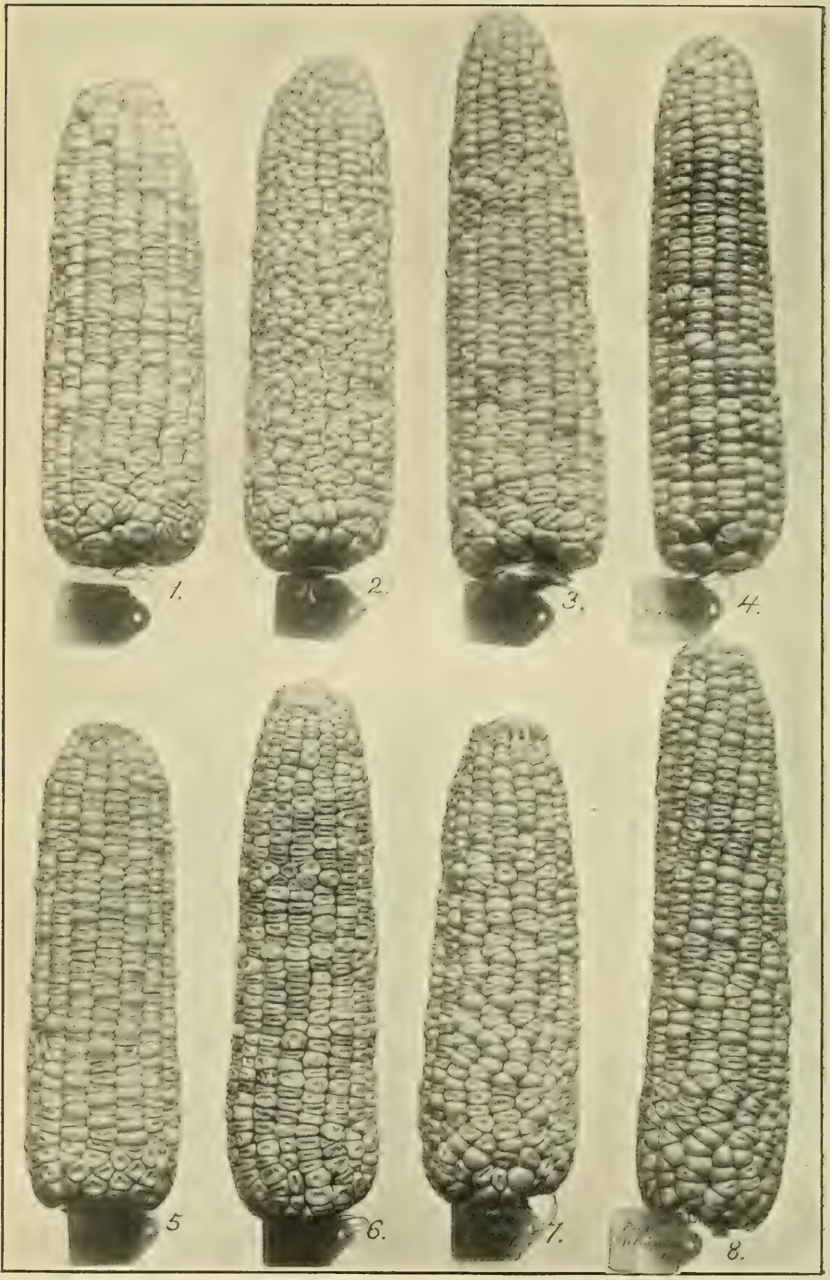

PLATE VI. *Blend Ears of Field and Sweet Corn.* "Silver Mine-Stowell" at 1; "Silver Mine-Country Gentleman" at 2; "Silver Mine-Old Colony" at 3, and "Silver Mine-Metropolitan" at 4. At 5, 6, 7 and 8 are representative ears of "Pride of Nishua" upon "Stowell's Evergreen," "Country Gentleman," "Old Colony" and "Metropolitan," respectively.

concerned the crosses that were secured the previous season of "Iowa Silver Mine" (144) and "Pride of Nishua" (145) upon various sorts of sweet corn and recorded in the report (with a plate) for 1906, pages 396–401. The "Iowa Silver Mine" is one of the leading white dent varieties grown in the Middle West, and was obtained along with the "Pride of Nishua," a yellow sort, from a breeder of field corns of distinction in his region.

The points in mind in securing these crosses were many, some of which were strictly practical, while others partake more of the theoretical nature. Last year as breeder rows the two Iowa field corns grew to the height of nine to eleven feet, and overtopped the varieties of sweet corn among which they stood. It is possible that some addition to the size of the stalk and vigor of growth may be an addition to table corns, provided there is no great sacrifice in quality. The longer period of growth does not lead to any hope of securing an early sort in this way, but, if additional strength of plant, handsome ear and desirable length of grain, with sweetness and prolificness are secured, there are ways in which speed may be added to such a type of corn.

Let it be noted here that the planting of the set of crosses under consideration was made as late as June 20th, that the season was not of the best for the crop, and in September all the plants were prostrated and partially uprooted by a heavy wind and rainstorm, that after being reset they were again torn down two weeks later, and killing frosts came upon the tenth of October. And yet, after all these vicissitudes, on the fourteenth of October a set of ears was taken from the badly broken stalks that is shown in Plate VI., one hundred and sixteen days from the time of planting.

Plot 1 was planted with seed from an "Iowa Silver Mine" ear that was produced in the breeder row of last season as a kind of check or means of comparison of the crosses grown in the other plots. The plants were of the large type characteristic of the variety, but much smaller than when grown under the favorable conditions that surround this field corn in its home in the highly fertile soil of Iowa. The ears in the present crop showed many sweet grains, thus indicating that the dent grains used as seed carried in latent form the sweet character which became manifest in the kernels of their progeny when both the combining germs contained the character of sweetness as against those with the starchy quality.

Plot 2 was a variable plot of stalks, some much larger than others. Number 1 in the plate represents the sample ear gathered before the others for the photograph. In this instance, as with all the others shown in the same plate, the ears are not the choice of the husked crop, but a single one taken before the others with the hope that the leaving of the bulk of the ears upon the stalks for a few weeks more might improve the grains for future planting. This "Silver Mine-Stowell" ear is of large diameter and fair length, with probably one-quarter of the grains sweet, they being shown as plump, while the starch-bearing ones have already become dented.

Plot 3 was planted with flint grains from "Country Gentleman" ear in the breeding plot of last year, and the plants were of a size and variety that compared well with those of the other plots. A sample ear is shown at 2, and is seen to be of larger size than the average "Country Gentleman" and has its characteristic zigzag arrangement of the grains which are of a very desirable length. Here again, the sweet grains are still plump and are behind the starchy ones in assuming their natural wrinkled shape when dry.

Plot 4 was planted with crossed grains of "Silver Mine" upon "Old Colony" and the result, so far as can be now judged, is quite satisfactory inasmuch as type of plant and ears is concerned. As yet, nothing can be said of the quality of the strain that may be developed from this cross. The ear shown at 3 is perhaps too tapering to suit the fancy of the expert, but it is possible that this is not so evident in other ears. Aside from this, the well-filled out tip is quite acceptable.

Plot 5 contained a block of plants of the cross of "Silver Mine" upon "Metropolitan," and the sample ear shown at 4 is more slender than the others in the plate. As elsewhere, the sweet grains stand noticeably above the starchy ones because the latter have become dented at their tips.

Plot 6 contained a set of plants in which the "Pride of Nishua" is the male parent of the cross and the "Stowell's Evergreen" is the female. This introduces the yellow color and the ear selected from the photograph (No. 5) shows that two unit characters are represented, namely, the texture and the color of the grains, and the yellow and the dent being dominant are three-fourths in number and the white and the sweet, recessive, are one-fourth. In shape and length of grain, the ear shown is desirable.

Plot 7 produced a set of the blend plants of "Pride of Nishua" and the "Country Gentleman," but the sample ear (No. 6) does not show the zigzag character of the mother. This plot grew alongside of one of the "Voorhees Red" and some of the grains are marked with dark color from it. Probably, all mixing is thus marked and the original crosses in hand can be kept pure by casting out the grains showing the dark color, which may become the starting point of another line of breeding if so desired.

Plot 8 contained the "Pride" upon "Old Colony" and the sample ear is thick-set and taper-pointed with the grains irregularly placed; that all the ears are thus marked is doubted.

Plot 9 was among the latest to mature and suffered most from the uprooting that prevailed. The sample ear is long and somewhat like the "Silver Mine" upon the same sweet sort, "Metropolitan." This may prove to yield the best shape of ear in the whole set, but the irregular lines of grain are not indicative of good breeding.

Experiments with Corn upon Smock Land.

The Smock Land, recently received by Rutgers College through the generosity of Dr. J. C. Smock, was not in the best condition for breeding purposes, and the results upon the four acres assigned to the Botanical Department are far from conclusive in many respects. The area of a trifle more than four acres is in the form of a rectangle, somewhat midway of the whole thirty-five and a half acres and permitted of the growing of a breeding block of corn the whole two hundred feet across one end and small square plots of twenty-five hills along each side a hundred and fifty feet from the other similar patches and something more than this from the corresponding set of plots upon the opposite side of the area.

Some notes are given below upon the plantings upon the ten plots above located, and of an equal number alongside of each with other crosses of corn at a later date to reduce the mixing to the lowest terms possible with the adopted plan.

Plot 1. "Black Pop" upon "Country Gentleman" (137/19). White sweet grains. No plants produced ears.

Plot 2. Planted with white flint grains from same ears as for Plot 1. A few fair-sized ears resulted which varied from straight rowed and nearly white to zigzag ears with three-fourths of the grains dark purple.

Plot 3. Planted with "Black Pop" upon "Country Gentleman," pure black flint grains. The ears were too few and small to permit of an opinion of the test.

Plot 4. Planted with "Black Pop" upon "Country Gentleman," black sweet grains. Only two small ears were produced.

Plot 5. Planted with "Golden Bantam" upon "Ruby," purple grains and cob. Of the twenty-eight small ears, ten showed purple grain and cob; nine purple cob and two of these solid yellow, while nine showed no purple and all but one were solid yellow-grained.

Plot 6. Planted with same as No. 5, excepting that yellow grains from ear with purple cob were used. There were only seven small ears; four with purple cob and grains three-fourths yellow and one quite white and three were the same in grains but showed no purple in the cob.

Plot 7. Planted with white grains from same three ears as No. 6. Here the land was somewhat better and results are approximately a fair crop. Two ears purplish throughout, one-fourth yellow grains. Sixteen ears purplish throughout, all white grains. Six ears white throughout, cob, grains, etc., excepting that one had a few pink grains.

Plot 8. Planted with purple grains from ear with white cob and yellow grains. Four ears purple cob and grains, three-fourths yellow. Seven ears purple cob only with grains three-fourths yellow. Four ears no purple, grains three-fourths yellow.

Plot 9. Planted with yellow grains from ear with white cob. The crop was a failure, there being only three small ears; one with purple cob, purplish grains and three-fourths yellow; one with white cob and purplish grains, three-fourths yellow and one with no purple, grains three-fourths yellow.

Plot 10. Planted with white grains from ear with white cob. Three ears showed purple tinge in grains, one ear white cob and solid yellow grains, three ears white cob and half the grains yellow. Six ears white cob and solid white grains.

The results with the "Golden Bantam-Ruby" cross are too meagre to warrant any conclusion along the line intended, namely, the nature of the purple color of cob and grain as regards the Mendelian law of inheritance.

In the second set of plantings upon Smock Land (June 20th) the following results were obtained:

Plot 1. Planted with Pop Corn upon "Black Mexican," selected rose-colored grains. Failed to fruit.

Plot 2. Planted with "Red Pop" upon "Black Mexican," sweet grains. Failed to fruit.

Plot 3. Planted with "Red Pop" upon "Black Mexican," flint grains. Failed to fruit.

Plot 4. Planted with "Golden Bantam" upon "Premier," yellow flinty grains. Failed to fruit.

Plot 5. Planted with "Golden Bantam" upon "Essex Early," yellow flinty grains. Failed to fruit.

Plot 6. Planted with "Malamo," pinkish grains. Failed to fruit. Plots 7–10 were planted with crosses of "Iowa Silver Mine," a large white western field corn, upon sweet varieties and similar crosses of "Pride of Nishua," a western yellow dent sort, but the plots all failed to produce results.

Reports of Testers of "Golden Bantam-Essex Early" Cross.

"Corn yellow, ears good length for size stalk, perfectly formed and sound, sweet and tender." "This corn came up fine, each stalk eared well, but most of the ears had very few grains. The quality of the grain was sweet and fine." "An excellent medium early corn. Plant of medium size, ears from eight to twelve rows, large kernels, delicious quality." "Very fine; plant tall and thrifty; grain tender and sweet. It was so good to eat that we could not resist eating all of it." "Came up well, and grew finely; quite sweet flavor." "Plant medium size, much larger than 'Golden Bantam' strong, vigorous grower, about five days later than 'Bantam;" the ear is much larger than 'Bantam,' about 80% of the grains yellow, quality excellent, very sweet." "Flavor good, plant short, all ears early." "A promising cross; grains of good quality."

Breeding Plot of Sweet Corn— Smock Land.

The whole eastern end of the Smock Land was used for the breeding of sweet corn and three breeder rows extended lengthwise of the plot, that is, 200 feet and contained 50 hills each. These breeder rows are numbered 4, 8 and 12, and, at right angles to them, were the 50 rows each consisting of 12 hills as follows: 1, 2, 3, (Br.), 5, 6, 7, (Br.), 9, 10, 11, (Br.), 13, 14, 15. "Voorhees Red" occupied Row 4; "Mexican" long flint, Row 8, and yellow grains of "Golden Bantam-Stowell's Evergreen," Row 12.

Consideration of the Breeders.

Row 4, as previously stated, was planted with the "Voorhees Red" that crosses of it upon the fifty white sweet sorts might be secured. The "Voorhees" is a variety that originated by breeding the "Black Mexican" (a kind of very superior quality but having a dark color when ready for the table that is objectionable), upon the "Egyptian," another standard variety of the white group. The combination that was secured by selection has dark red mature grains and, at the time when ready for the table, are of an attractive pink color. With the hope of securing some combinations that might be an advance on either parent, it was particularly in mind to determine how this red sort would blend its color with the white varieties. Some have the opinion that it might not act as did its ancestor, the "Black Mexican," but instead the cross would show two shades of color, or possibly the result would be a black-colored grain. In other words, there was a twofold reason for making the "Voorhees" a breeder, namely, the improvement that might possibly come of it, and, secondly, the hope of light upon the behavior of a unique colored sort that resulted from a combination of a black and white parent.

Many dark colored grains have been secured upon a half of the varieties represented in the plot, and these show all degrees of discoloration, from a faint pink to grains that are practically black; many are variously clouded and mottled, the outcome of which is left for future crops.

The second breeder row was occupied with a long flint variety, brought by Director Voorhees from Mexico. The intent here was to secure an infusion of foreign "blood" into the standard sorts of sweet corn and, if possible, lengthen their grains and thereby increase the percentage of edible material in each ear. This "Mexican"—no other name for it being known—is a very tall growing sort with pink, hairy stalks of twice the average length of those surrounding them, and so late in blooming as to almost prohibit the securing of any crosses. It seems evident that, whatever the good points hoped for as to length and shape of grain, the slowness of growth may condemn at once any crosses that are obtained with it. For speed, and this is the *sine qua non* of early sweet corns, it is evident that to go north rather than south for breeders, is advisable. However, something may be in store from the very long "shoe-peg," "Mexican-American" crosses, into which quickness of growth may be bred, as the results may determine.

In the third breeder row were planted the yellow grains of a cross of "Golden Bantam" upon "Stowell's Evergreen" with the hope of getting crosses that would be better than either parent. Seeds of such combinations are secured from the ears of several of the white sorts.

It is seen that this open, free air breeding has been between fifty-three sorts but only sets with three of these are recognizable. The scheme rests upon the fact that a flint sort, the "Mexican" in this instance, marks itself by producing a flint grain whenever its pollen fertilizes a sweet grain. In a similar manner, the pollen carrying yellow impresses this color whenever it produces a grain upon an otherwise white ear. It is probable that the "Voorhees Red" has followed the same rule of the dominance of color over no color and the dark grains are all crosses with it. In short, all flint grains—and they are in this instance rare—show crosses of the "Mexican;" all yellow kernels are crosses of the "Bantam-Stowell," and all dark grains, a blending of the "Voorhees Red" with the white sorts. Of course, the fifty white kinds have crossed much with each other, depending, possibly, upon time of blooming in most part, but experience teaches that among corns there may be affinities that account for some of the differences in this regard.

Conditions for this Crop.

The breeding plot was located upon land that had been recently acquired and was not in a high state of cultivation, and combined with this, was a season that was remarkable for its backwardness. The table of climatic conditions for the crop-growing months of April and May for the past nineteen years, given upon the last pages of this report, show that they were seventh in the amount of rainfall, nineteenth in the amount of heat (that is coldest) and thirteenth in the amount of sunshine.

Another discouraging feature in the making of this experiment was the unlimited number of crows, which a wood lot close by made it difficult to control, for the field is at the rear of the College Farm and a long distance from the other breeding grounds. The first planting was generally uprooted and the second one, only saved by use of various scarecrow devices. Worst of all, as the grains came into the milk stage, the plot was invaded and the tying of bags upon the ears was not sufficient to secure the crop.

EXPERIMENTS WITH TOMATOES.

A somewhat different field treatment than formerly was given to the tomatoes the present season. The hills were made four feet apart each way and the usual hand-tillage was almost entirely replaced by horse-culture. A test was made of growing two plants in a hill, in many instances, with good results. Both stakes and wire frames were also used for holding up the vines with marked success.

Old Varieties Grown the Present Season.

Only a few of the commercial sorts of tomatoes had a place in the breeding grounds, this limitation being due chiefly to lack of space; they were as follows: "King Humbert" (64), "Magnus" (75), "Dwarf Stone" (123), "Dwarf Champion" (153), "Yellow Prince" (148), "Model" (163), "Red Pear" (179), "Red Plum" (180), and "Laycock" (213). Each of these was grown for some special purpose, in connection with the breeding work as, for example, the "King Humbert," "Red Pear," "Red Plum" and "Laycock" for their length of fruit and the "Magnus" for its coarse foliage and the "Stone" and "Champion" for their dwarf plants. The "Station Yellow" (210), a home creation, was grown for further study and also the "Oligosperm" (220), which is the "Giant" under a new name, which means few-seeded, and concerning this last a special treatment is given elsewhere.

Varieties Not Before Grown in the Gardens.

No. 221. *"Hummer."* This sort had stout plants that were late in bearing fruit which, while smooth, red and apple-shaped, were too variable and often too small to give satisfaction.

No. 222. *"Superb Salad."* The plants of this variety were medium sized and fairly early, but for a field crop the fruits were too small. It might serve as a forcing variety where medium-small fruits are desired.

No. 223. *"Red Rock."* The plants were medium-large and early, but the flattish fruits, often quite misshapen, did not fully please.

No. 224. *"Sunnybrook Special."* The plants were small and bore fruits of medium size, fairly early.

No. 225. *"Carter's Sunrise."* Plants were very long and spreading with a suggestion of the "peach" foliage. The fruits were small and in large clusters.

No. 226. *"Florida Special."* The plants were small, the fruits red, smooth, but too variable in size.

Notes Upon the Crosses.

The chief end sought in the breeding for the present season was the increase in the polar axis of the large-sized fruit, the hope being to get a tomato that would permit of more fine slices than the best now upon the market. From the lack of a better term, that of "goose-egg" has been used in connection with this ideal fruit. The long tomatoes (those that are of the shape of a date, but much larger) are practically worthless, because of the very limited number of the large seed cavities—usually two, and the consequent flabbiness of the fruit. To breed into these fruits, as illustrated by the "King Humbert" and the "plums" and "pears," an interior that is "meaty," having many small seed-cavities and surrounded with a thick wall giving a solid interior and smooth exterior, is one of the leading features of the work. Along with this goes a study of the nature of the plant in all its characters and the selection of types that give promise of being an advance upon the varieties now in vogue. The season's work indicates that some progress has been made toward the desired ends and while the quest goes on the immediate results in the form of desirable kinds will be furnished to the tomato growers of the State for a practical test.

The number of crossed plants was more than two thousand, and space does not permit in this report of giving more than a brief note upon some of the most promising, while the large majority can have nothing more than the field notes as made in the record book. In this book the crosses are given in the order of the record number of the male parent, that is, if No. 1, "Acme," is crossed upon several as "Arcadia" (No. 5) and "Bright and Early" (No. 14) and "Nolte's Earliest" (No. 94), such crosses come before those of "Bright and Early" upon "Acme," "Nolte's Earliest," etc.

A large majority of the crosses of the present season were compound, that is, a combination of two crosses. Thus, a set of plants that gave some promise for length of polar axis combined with other desirable qualities is booked (page 5) under the following numerals: 1/5///103/181//33/53. The single slanting (fraction) lines indicate the first crosses between the numbers they separate; thus, 1/5 shows that "Acme" (1) was crossed upon "Arcadia" (5); 33/53 indicates that "Earliana" (33) was crossed upon "Fortune" (53); next, 103/181, that is, "Ponderosa" (103) upon "Sumatra Fig" (181), was used as the pollinator for the "Earliana-Fortune" cross indicated by the double slanting lines and, finally, upon this combination the "Acme-Arcadia" cross was bred, as shown by the three slanting lines between it and the other portion of the combination. In this complicated breeding, two parents, namely, "Arcadia" and "Earliana" tend to make the resulting plants early, while the "Ponderosa" is excellent for a large percentage of flesh, many locules and few seeds, and the "Sumatra Fig" is designed to add length, because of its slender pear shape. As a result, the plants as a whole, showed desirable qualities in the length of the polar axis, the fine flesh and good interior generally, but they varied in this regard and in fact were, as to be expected, far from uniform. Seeds were saved from the choicest plant, and, furthermore, a fruit was secured from fertilization within the plant for further special study of the combination. In the midst of all this union of various sorts, the two colors, "red" and "pink," kept themselves quite distinct and were evenly divided between the two. The colors are among the most difficult of the tomato characters to blend.

"Crimson Cushion-Sumatra Fig" Cross (26/181).

This cross is mentioned not because of great worth the present season, but for its variability and possibility of producing something good in the future. There were two rows of plants, one from seeds of a red fruit and the other from a yellow tomato. The plants were all remarkable for their large size and great length. Of the four plants from the red fruit seed, one was a yellow "plum," one a long "apple" and two were flat like the large-fruited parent.

These latter plants showed remarkable variation in the fruit in the same cluster, as if the attempt was made to illustrate all the intergrades between the fruits of the two parents. All the plants from the yellow-fruited seed produced yellow tomatoes, which is according to rule if yellow is the recessive color. One plant had its fruits very flat and broad with many deep ribs, thus giving a new type for yellow tomatoes, but one that seems to be of no practical value. The fruits of the other plants were more acceptable as being of large size for a "plum" type of tomato.

"Dominion Day-South Jersey" Cross (29/119).

The second generation of this cross was grown and the results are so favorable that seed was saved extensively for purposes of trial outside of the Breeding Grounds. All the plants were uniformly early and prolific, and the fruits had a smooth apple shape, ripening evenly and cracking but little.

"Duke of York-Ivory Ball" Cross (32/175).

Seeds were used from a "white" fruit of this cross for 1906 for the test the present season. The plants were unusually large and spreading, and of the four plants one was a fine red in fruiting and three were pale lemon, the former bearing good-sized tomatoes, but all the latter had fruits of plum form and shape and too small for general use. The fruit of most interest, aside from the great size of plant, was the one with a color that agreed with neither parent, and, in fact, might have been mistaken for the sort called "Golden Nugget." The possibility of getting a very productive, long season "plum" of striking color led to the saving of seed for a further trial.

"Earliana-Freedom" Cross (33/54).

This was an early fruiting cross bearing red fruits of two types, namely, five plants with flat "Earliana" type and three of a handsome apple shape that did not crack. Seed of the latter type was saved.

"Earliana-Yellow Peach" Cross (33/186).

The plants were long and slender and showed unmistakably the "peach" foliage. One plant bore large yellow fruits that showed a new type of tomato that set people to guessing when first seen. The fruits were of large size, quite long, yellow and deeply ribbed, or fluted, thus resembling a small, scalloped squash, with a poor interior consisting of few large locules and,

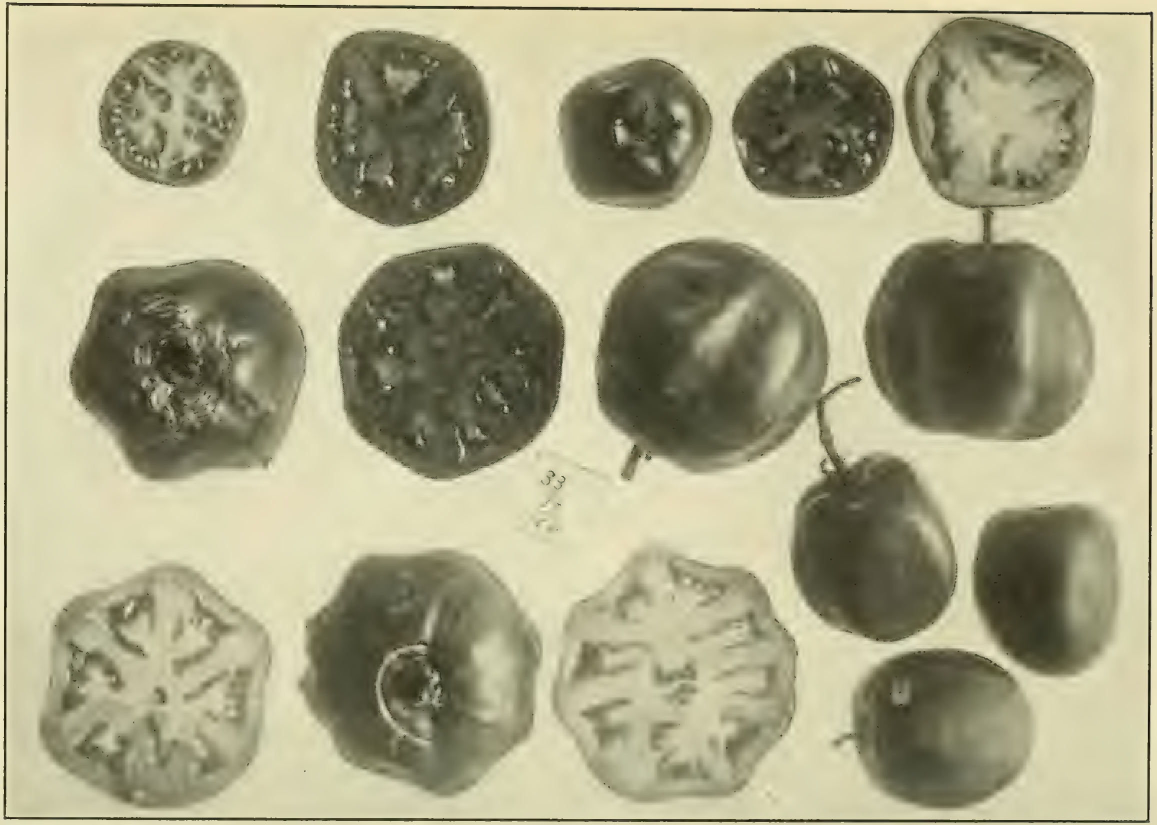

PLATE VII. *"Earliana-Yellow Peach" Tomato Crosses.* Side, end and interior views are shown of these peculiar fruits; the deeply corrugated nature of the large fruits is seen at the right of the middle and also in sectional view near the bottom of the engraving.

therefore, flabby; the corrugated exterior had the fuzz of the "peach." An attempt is made to show something of the peculiarities of the fruit of this giant "peach" in Plate VII., along with specimens from the other plants of the same set which were of the "peach" coating and texture but took the red color from the "Earliana." The card with record fraction is an inch square. Seed was saved of the giant-fruited type only that its progeny may be studied, without, however, much hope of valuable practical results.

"Earliana-Jewell" Cross (33/66).

In this cross, the fruits were quite uniform and showed some desirable length of the polar axis. On account of this and the early crops of fine fruits, seed was saved from hand-worked flowers.

"Earliana-Bright and Early" Cross (33/14).

The plants under this combination were of only medium size, but the fruits were bright red and fine apple shape and a quantity of seed was saved for possible distribution.

Some "Giant" Crosses.

The "Giant," as the name implies, is a variety that produces large plants and exceptionally large fruits but of the flat type often much ridged and with a solid core. A leading thought in using it is to develop a fine, firm, fleshy center in the cross and, at the same time, reduce the number of seeds. When worked upon the "Globe," the result is a variable fruit usually without great merit, but occasionally producing a long and pointed tomato of desirable size and showing a fine interior structure.

A combination of the "Giant" with "Globe," "Bright and Early," and "Nolte's Earliest" did not bring the desired shape, structure or earliness. Much better results were obtained with the quadruple cross of the "Giant," "Globe," "Earliana" and "Jewel," from which strong plants with long fruits combined with earliness were secured. Practically the same results came from a cross in which "South Jersey" replaced "Earliana" in the combination last mentioned. This might be expected as "Earliana" and "South Jersey" are of the same type. The "Giant" with "Globe" and "Red Pear" gave a fine large "plum" that may develop something acceptable. This is a good instance of the "leveling power" of a small-fruited variety. There were many instances of this the present season as the "plum" and "pear" types were used upon a wide range of varieties to breed in the long polar axis of the fruit.

The "King Humbert" Crosses.

The "King Humbert," as a good representative of the long tomato but having little else of value as a high grade fruit, was represented the present season by forty-four crosses with it as the male parent and nearly as many more where it has been worked upon by other varieties. Speaking generally, the "Humbert" being of a small type, and, therefore, it is assumed, nearer to the wild condition, had the effect, as remarked above, of reducing the cross to the size and shape that goes under the name of "plum." When the combination represented three or more varieties "pulling against" the "Humbert," the size was reduced and the form, instead of being that of the plum, was nearer the apple as that term is used among tomatoes. This is true when "Fortune," "Acme" and "Arcadia" were in the combination. The cross of "Humbert" with a cross of "Giant Climbing" with "Ponderosa" gave large plants, one approaching the filiform type of foliage and with fruit of desirable length and size. In some of these sets of crosses, the plants were very variable and, while some were plum-shaped, others were irregular like the fruits common to the growers of tomatoes twenty-five years ago, and giving some suggestions as to the possible methods that have been in vogue in developing the more modern types of fruit.

The "Humbert" has been bred to the "Laycock," a variety procured from England last year because of its superior length, and the crosses this season have shown the long plum form, with the loose interior of the "Humbert" but little improved. Experience may teach that the desired end may be reached by a gradual approach instead of the attempt to strike averages between extremes.

The "Magnus" Crosses.

The "Magnus" variety of tomato has always shown good qualities of plant and fruit upon the Breeding Grounds, and the present season it entered into forty crosses. The apple shape of the fruit and its thick wall is often strongly impressed upon the cross as evidenced in "Magnerosa," which is a combination of this variety with the "Ponderosa."

Some good results have come from breeding the "Magnus" with the "Dwarf Champion" and with the "Yellow Prince." Two crossed plants this season had the coarse ("potato") foliage of the "Magnus" and the yellow fruit of the other parent. With "Alice Roosevelt," a fruit of fine size and length was obtained, and with a cross of "Giant-Globe" mingled with the last, a prolific and desirable combination was secured. One of the most hopeful of the crosses for the "goose-egg" type of large fruit was obtained from a combination which in the record book is expressed as follows, 75/103//103///103/181, which means that the cross of "Magnus" upon the "Ponderosa" (that is, "Magnerosa"), was next crossed upon the "Ponderosa" and this derivative cross was bred upon the cross of "Ponderosa" upon "Sumatra Fig." The "Ponderosa," a broad, meaty-fruited sort is represented three times and the medium long "Magnus" and the very long "Sumatra Fig" but once. From such a blending of the length and breadth at the same time, keeping the flesh in good condition, it is hoped to get an acceptable type of marketable tomato.

The "Stone" Crosses.

Some of the "Stone" crosses showed much to give encouragement to the breeder, thus the one with "Brinton's Best" was gratifying as a choice set of plants bearing large red fruits of apple shape. Seventeen such mature tomatoes were taken from a single plant upon September 7th, each showing the center well broken up into small cavities. The seed was saved for distribution. The same cross, when bred to the "Magnerosa," gave prolific plants, some pink-fruited and others red, thus offering two styles of tomatoes as to color. A cross of the "Stone" with "Earliana" bred to a cross of "Giant" upon "Globe" produced some plants remarkable for their large smooth fruits.

The "Dwarf Stone" Crosses.

The "Dwarf Stone" was freely used because of its compact form of plant and solid fruit and some of the results were particularly desirable. New types of plants may be obtained, that is, the dwarf habit with various shapes and sizes of fruits that, while novel, may not be profitable. Thus, the combination with "Yellow Pear" gives a small, yellow-fruited dwarf plant that may have its place in some gardens.

The cross with "Enormous" last year attracted much attention upon the grounds, but this season it did not do as well. One of the best rows was the "Dwarf Stone-Ponderosa" cross in which much desirable length in the fruit was shown. That they were productive is evidenced by the statement in the record book that forty-seven ripe pink, apple-shaped fruits were gathered from a plant at one picking. It was not a dwarf, and seed was saved for further testing.

The most successful cross under this head, so far as the crop for the present season is concerned, is that of "Dwarf Stone" upon "Golden Queen," of which twenty plants were grown and by discarding the dwarfs in the seed box only standards (with one exception) were represented, and they were of fine vigor and satisfactory productiveness. The fruits were somewhat above the size desired by the market gardener—not a grave error, as it is easier to reduce than to increase the fruit—and they were of a bright ("cherry") red, smooth and, best of all, solid, with the core well broken by small seed cavities. A photograph was secured of some of the fruits, but not until the best of the crop had been seeded for distribution. The "Dwarf Stone-Extra Early Tree," contrary to the name, was too late.

"Gold Ball" Crosses.

The several crosses of the "Gold Ball" did not bring anything promising from the commercial standpoint, but some facts of interest in breeding were gathered. The "Gold Ball" is slow and it deeply influenced all its crosses in this respect, but its color fell into the category with other. yellow-fruited tomatoes and gave one-quarter of its own color when bred with red and pink sorts. When crossed with "Ivory Ball," which is a kind with its small fruits of a pale shade of yellow, there was produced a variety of shades of lemon as though the yellow of the "Gold Ball" had been diluted by the "Ivory Ball."

The "Globe" Crosses.

The "Globe," a pink variety with fruit of a well-developed apple form and, therefore, with its polar axis long for the equatorial diameter, has been freely used in the attempts to get a fruit that has much greater proportional length. Of the combination with "Brinton's Best," there have been grown a row of both the pink and red-fruited kinds, and both were practically alike excepting the character of color, and from these superior plants seeds from the longest fruits have been saved with much hope of making substantial gains toward the end sought. One set of plants was grown from seeds saved from a long fruit of last year, and here the most encouragement is met with. In the row where the "Red Pear" "blood" has been added to the above cross, the effect was to drag the offspring down in size to a level of the "Pear" but the neck was rounded out and a "plum" resulted. In the case of the "Red Plum," added as above stated for "Pear," the fruit became larger than the latter and might well be said to be a small "apple." It remains to be seen in the quest for length and its desired accompaniments, whether the "Pear" is better than the "Plum."

The cross with the "Duke of York" was disappointing, for the irregularity in the fruit was augmented and the lateness of the crop proved an objectionable feature. With "Imperial," some desired length was evident, but better results obtained with "Honor Bright," where the rich "cherry" color of fruit was combined with smoothness, great firmness and productiveness but no advance in length. In the many crosses with "Humbert," either alone or with one or more of several sorts, length was usually secured and from one plant where "Ponderosa" was thus added a long egg was in evidence. The "Globe-Magnus" has from the first shown good length and other desirable qualities in both the fine and coarse leaf types.

The "Red Currant" Hybrids.

The second generation from the blend of the "Red Currant" upon the "Dwarf Champion" was grown quite extensively the present season, and the formula for this set of plants is 177/154 B–1–5, B–5–9, etc. There were two general types of plants, namely those that were standard, that is, long, slender and wide-spreading, and the compact form that characterizes the dwarf plants. The latter are better because of their more restricted habit of growth, but are perhaps less fruitful. The tomatoes were borne in great numbers, and the clusters, adhering closely to the "Currant" type, were quite attractive with their numerous fruits of the size of cherries arranged in two rows along the common axis. It is likely that the output in pounds is as great from these hybrids as from ordinary large-fruited sorts, and the flavor of the tomatoes is so different as to make it possible for this combination to become somewhat popular when a "cherry" size can be employed. The types of foliage were shown in a plate in last year's report.

"Acme-Arcadia" "Red Currant-Ponderosa" Cross.

In this combination, there is first the union of the "Acme" and the "Arcadia" to induce more speed in maturing the fruit in the "Acme," the second union was between two species, namely, the small-fruited "Red Currant" and the enormous "Ponderosa" —and finally these two results were brought together. There were only four plants in the set and they were all quite alike in their long slender type of stem and the fine foliage of the "Currant."

It is evident that the last named sort has a very great influence upon the progeny for, while with it represented as one among four, it asserted its peculiarities very strongly. The fruits were of the general forms, namely, a small plum and a fruit that had the same general shape of the "Ponderosa," it being broad, flat and somewhat ribbed, and showed many locules when sliced, and contained a fair percentage of medium-sized seeds. Those who saw it were inclined to call it "Baby Ponderosa," and this became its "nursery" name. The fruits were borne in clusters somewhat after the manner of the "Currant"—they were all pink in color like the "Ponderosa," but had the number of plants been large it is probable that the red of the "Currant" would have shown itself freely. The "Currant" fruits have a flavor that is different from the ordinary tomato, and the combination in question contained this in a marked degree, so that there is hope of getting a fruit of marketable size with a distinct and very agreeable flavor.

The "Oligosperm" Tomato, No. 220.

One of the results of the breeding together of the "Dwarf Champion" and "Golden Sunrise," in 1898, is a mutant that has been preserved from year to year under the garden name of "Giant." The original plant, grown in 1899, was remarkable for its great size and has certain peculiarities of foliage associated with it. Furthermore, the fruits were below the size naturally expected in the cross and quite limited in number, and contained almost no seeds, many being entirely seedless. The plants, in all the succeeding generations, have repeated closely the parent type, and from it has come a tomato that appears to merit specific distinction.

For several seasons, repeated attempts have been made to breed this tomato with the ordinary types, but until the present year the records show only failures. To what this lack of success is due is not clear to see. Those who have had this work in hand claim that there seems to be no lack of good, plump pollen. During the present season, a greater effort than usual has been made to secure crosses, and out of many attempts three have given fruits, two of which had but one seed each and the other eight seeds, the latter being a cross with the "Red Pear."

This "Oligosperm" (meaning few seeds) is a yellow-fruited sort, getting the color, it is to be presumed, from the "Golden Sunrise" parent in the original cross. Coming as it did, in a block of plants all from the seeds of the same fruit and in which one-quarter were yellow, there is not much room for doubting that the plant in question arose in any other way than that indicated. It seems possible to consider it as a case in which a plant has taken on characteristics that are either new, or such a combination of old ones as to appear sufficiently marked to deserve a special mention in any complete classification of the tomatoes.

During the present season, a block of plants has been grown sufficient to provide for a quantity of seeds to be used in a limited distribution. As each fruit yields but, perhaps, a twentieth of the number borne by ordinary fruits, the packets, of course, can contain but few seeds. It is desired that those who are interested in the peculiarities of this tomato may have an opportunity of growing it. The practical trucker will not find it to his advantage to use it, for the plants are late in fruiting, and, as before stated, the tomatoes are small, rarely over two inches in diameter, but are of a peculiarly agreeable flavor. It is also important to test this tomato under other circumstances than those where it originated, as it is possible that a change of environment may induce some modification of advantage.

The chief hope of the "Sport" is that of breeding it to the ordinary sorts, with the thought of improving the quality of the latter and materially reducing their seediness.

Plate VIII. shows the "Oligosperm" fruits—a portion of a single picking—as grown the present season. In the center of the plate are two pairs of ripe fruits with portions of their stems, with one fruit above them showing the blossom end and one below with the calyx in view. Beneath the latter are the two halves of a fruit that resulted after the pollination with one of the ordi-

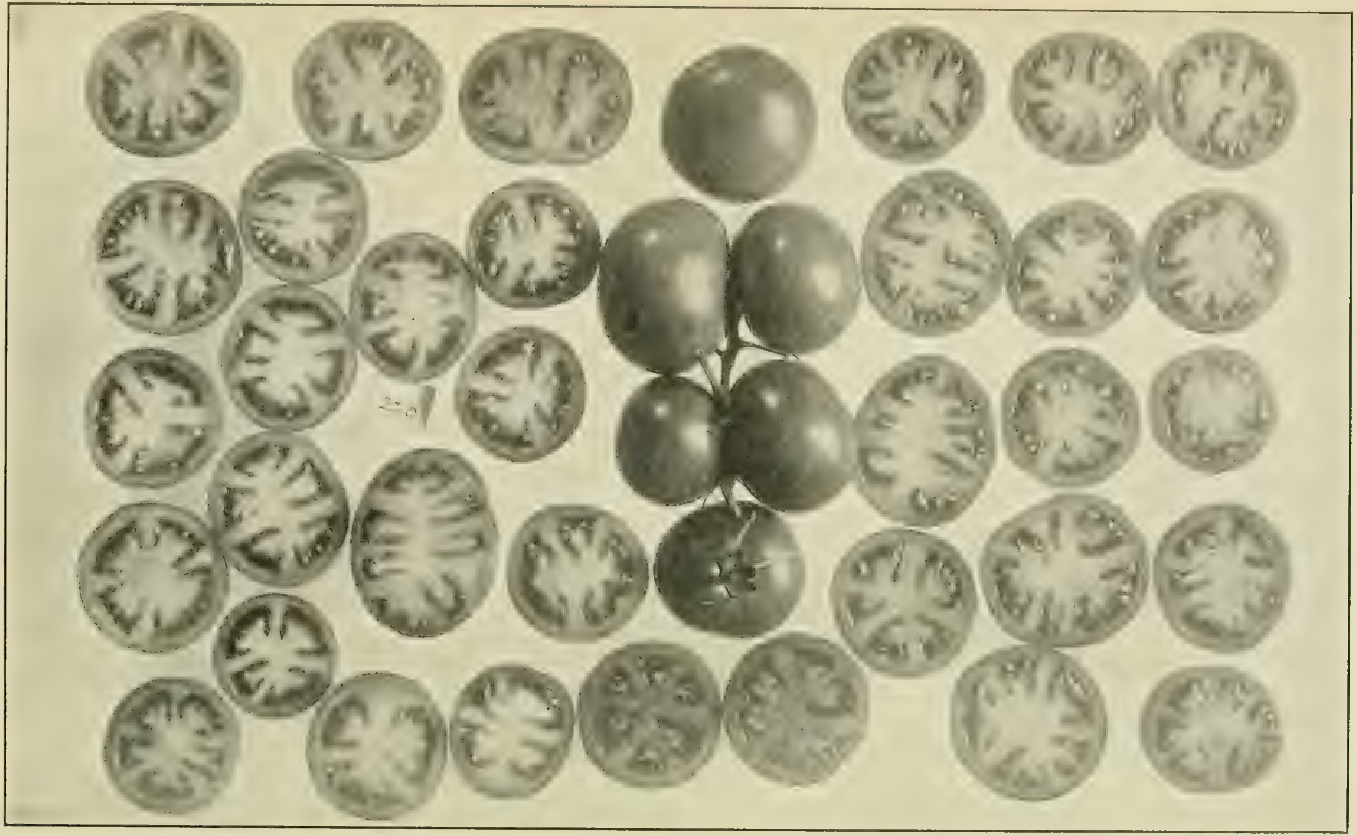

PLATE VIII. *The "Oligosperm" (few-seeded) Tomato.* Six whole tomatoes are shown in the middle of the group and, upon either side, halves of thirty-three fruits, some of which are entirely seedless.

nary sorts. It is entirely seedless, as is the rule when the flowers are hand-worked. The other portion of the plate shows one-half of each fruit, making in all thirty-nine tomatoes represented. A card an inch square is introduced to indicate size of the fruits and the number (220) it bears is that of this sort in the record books, and any results of crossing with it that may be affected.

A study of the slice-views will show that the number of seed cavities (locules) ranges from three to seven. The general absence of seeds gives a conspicuous pulp cavity, but because of the thick, but tender wall, the fruits are not flabby and keep well.

Tomatoes with Yellow Foliage.

The field of tomatoes has shown several plants with the characteristic yellow foliage. Such plants, while they have a sickly appearance, do not seem to be suffering from any disease. It is possible that the plants with this character do not mature their fruit quite as early as those with ordinary foliage of the same cross.

The following crosses showed the yellow foliage: "Freedom" upon the cross of "Honor Bright" upon "Freedom" (54//60/54), three out of the four plants, which was a large number, considering that "Honor Bright" is the variety that carries the yellow foliage. In the cross of "Honor Bright" upon "Honor Bright-Fortune" (60//60/53), there were only two out of ten plants with the yellow foliage. In another compound cross, as above, with "Frogmore" in place of "Freedom," the yellow plants were two out of five. In the cross of "Aristocrat" upon "Princess" (149/109), the first generation, the yellow plants were three yellow and one green and in the cross between the "Dwarf Champion " and "Dandy Dwarf" (153/158), all four plants showed the yellow color.

There is much to be done to satisfactorily determine the nature of the yellow foliage, but there are strong indications that it is a unit character (*unum*) with the green foliage as its opposite.

In the two present instances of the first generation, the yellow color shows in the blend in all the plants with one exception, but the instances in all cases are too few to admit of any conclusions being drawn. As yet, not being impressed with the economic importance of the yellow foliage, the observations upon it have been entirely an aside.

This yellow foliage is not usually very noticeable until after the middle of the growing season, when it is so evident that the plants with it are easily seen among their green associates. A cursory study of the plant seems to lead to the impression that they have fewer of the glandular hairs than the ordinary foliage and through them there may be a way of reducing this disagreeable coating of rank-scented gummy substance.

The fruit of plants with yellow foliage behaves differently than that of the ordinary because of its losing its green color and being nearly white (lemon-white) for several days before it begins to take on the red or pink. In the row of "Aristocrat-Princess," two of the plants with the yellow foliage bore fruits that were yellow when ripe. This may be a novelty among tomatoes but the advantage of it to the grower is not at present apparent.

Increasing the Length of Large Tomato Fruits.

The commercial tomatoes, for convenience of classification, may be divided into small and large, the latter making up the ordinary marketable sorts, while the former (grown only in comparatively small quantities) are used for special purposes. The smallest, from its size of fruit and arrangement upon the stem, is known as the "Currant" and, next to it in size, is the "Cherry," followed by the "Plum" and the "Pear," all of which words are applied because they express quite closely the size and shape of the tomatoes. In the second group, to which the truly commercial sorts belong, the smallest may be spoken of as apple-shaped, especially when the surface is smooth, and this term admits of a wide range in the relative length of the polar axis for some apples are quite flat and others decidedly longer than broad.

To elongate the polar axis of the commercial sorts of tomatoes is desirable for purposes of household economy and to obtain a fruit that has a smooth, thick flesh at the end where, too

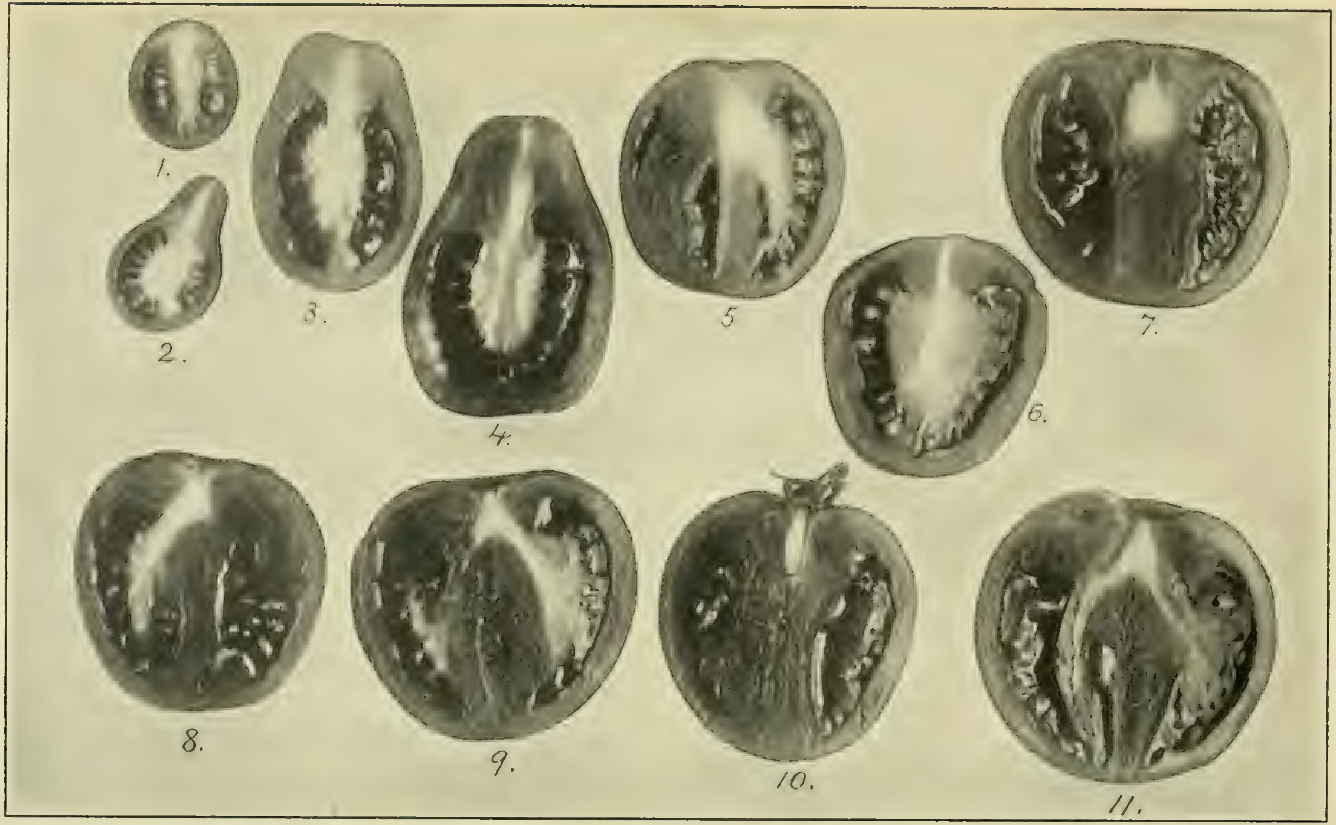

PLATE IX. *Tomatoes with Long Polar Axis.* From 1 to 4 are shown, in section, types of long small tomatoes as "plum" and "pear," and from 5 to 11 are similar views of fruits obtained by breeding for a long large fruit.

frequently, there is a navel structure of especial weakness because of its providing a means of access to germs of decay. Tomatoes, as now generally grown, lie upon the earth and the "blossom end," if rough with folds in the surface brings the pulp near to the skin and such are much more apt to rot than those that are uniformly thick-walled, pointed and guarded with a smooth surface.

Breeding for length, therefore, in the large-fruited tomatoes is between those that are long in the polar axis, as in the "plum" and "pear," and those sorts that will give breadth in the cross. The long, slender-fruited sorts, like those shown in the upper left-hand corner of Plate IX., as a rule have an objectionable interior, the seed cavities (locules) being few, often two, and of a type approaching probably the wild form. Such tomatoes are flabby, that is, the sides are not well filled out and the percentage of seeds and watery pulp is great and the solid flesh correspondingly small. The task of getting out of the fruits now known a marketably large fruit that has a long polar axis, far exceeding the equatorial diameter, and at the same time a satisfactory flesh is one to which the department is addressed. The "goose-egg" type is the desideratum in which the locules shall be many, the central core broken and the slice show throughout a "marbled" flesh of uniform rich color and but a single seed in each of the numerous cavities.

The hope is indulged that some progress is being made, as may be seen from an inspection of the fruits shown in longitudinal view in Plate IX. Original types are shown in the first four numbers; the others are all combinations. At 5, is a view of a fairly constant set of fruits that was obtained by a cross of "Ponderosa" upon "Sumatra Fig." The male is a widely known sort noted for its large size of fruit and has a low seed content. One of its chief defects is its flatness and irregularity, particularly at the blossom end where it is often broken and, in this respect, the two parents were nearly opposites, for the "Sumatra Fig," as the name suggests, is fig or pear-shaped, and the blossom end oval and smooth. The result of this cross has been a fruit that is a fair blend of the two in size and shape, and when, by further breeding with the "Ponderosa," the size is increased, a long fruit of much merit may be expected.

At 6 is a combination of the "King Humbert" with "Fortune," the former being shown at 4 while the "Fortune" is a good apple-shaped sort. The cross shows a fruit that is not unlike the one previously mentioned but averages somewhat longer and larger.

The fruit at 7 is one of a compound cross, in which the "Ponderosa" figures twice, the "Magnus" twice and the "Globe" once, and is represented by the following fraction: 75/103//103-///194/75. Here again, the "Ponderosa" (103) is used from its good qualities of flesh with minimum seediness, while both the "Magnus" (75) and the "Globe" (194) are employed to elongate the fruit slowly, at the same time retaining an interior that is of merit. It is not known what the ancestry of the "Magnus" and "Globe" may be, but presumably there is "blood," in one or both, of a so-called long type.

From another direction, a set of plants was obtained bearing fruits of the form shown at 8; it is not unlike the last but much earlier in its time of fruiting, a point that must not be overlooked in the production of any type of fruit. In the cross, the male parent is "Earliana" and its mate the "Jewel.' For forcing, when in midwinter medium-sized fruits are acceptable (if not preferred), this cross may prove desirable, for along with the fine shape and contents, it is quick maturing and productive.

The fruit at 9 is the result of a cross between the "Globe" and the "Ponderosa" and in many points is already a most desirable type of tomato, thick-walled, few-seeded, rich, and pink-fleshed; it gives much promise.

One of the nearest approaches to the "goose-egg" is a case in which none of the long sorts (so-called) played any direct part, for it is the derivative cross between "Magnus" and "Ponderosa," expressed by the fraction, 75/103//103—and, therefore, the large-fruited "Ponderosa" is very largely represented. At 10 is shown an average sample of the fruits of the combination in which the egg-shape is well seen, but in a fruit with several locules and a flesh that is solid and most desirable in texture and uniform color.

At 11 is a specimen of a derivative cross in which three varieties are combined as follows: 75/103//103///103//103/181. In addition to the lengthening influence of the "Magnus," there is the "Sumatra Fig" at work, diluted (so to say) by the "Ponderosa" "blood" before it is brought into combination with the "Magnus," which is likewise blended with the "Ponderosa."

Tomatoes Offered for Trial.

Last spring, only three crosses of the tomatoes were sent out for practical testing and one of these, the "Magnerosa," only in special cases because it was widely disseminated the year before. Twenty-five plants of it were grown upon the Home Grounds and the previous record was maintained for a superior midseason variety producing solid, smooth, pink fruits.

The following notes from the growers who received seed this season confirms all that has been previously said. Those who are growing it from the seed from their own crops of the previous year have not been asked to report.

Reports from Testers for "Magnerosa" Tomato.

"In good soil and properly irrigated, the result is very satisfactory. Plant very vigorous and productive, fruit, generally speaking, uniform in size, not quite as large as 'Ponderosa,' but better shape, being smooth and nearly round." "The 'Magnerosa' made a strong growth, and the fruit borne on the vines is smoother than that borne on 'Ponderosa' vines—also it seems to be more prolific." "Fruit solid and good quality, color right up to stem, smooth and uniform in shape, which approaches the spherical, color red, toned with lilac pink. The vines average from two to five feet in length and bushy in proportion, well set with fruit." "Plants were very large, having five or six branches very well filled with fruit, these were started under glass. The fruit is very uniform in shape." "This has proved itself to be a very good kind of tomato; it has a good flavor, it is large, smooth and a color which will make it sell. The foliage is a good green of good growth and free from all blights." "Strong growth, well fruited." "Vines very vigorous, large and productive." " 'Magnerosa' is doing well." "Is a very vigorous grower and I consider it productive, light pink in color, very solid and sweet, and under these conditions a very good addition to the garden." "Fruit small but shows up well, and plant sturdy and strong." "Tomato quite productive, medium size, fair, round, smooth, medium early." "A very nice and good tomato, the color is a bright red, the shape is round, the plant is a healthy, strong grower and very productive. I consider it a very good variety." "Free in growth, prolific in bearing, good flavor." "Good quality and very solid." "The tomato you sent me was an entire success, plants very large and vigorous; fruit very productive with a delicious flavor." "I am very much pleased with this variety." "The tomatoes were grand, the bushes were about five feet high, the leaves are large and a very dark green, and they weighed about a half a pound and they were fleshy." "Fine flavor." "The fruits are perfect in color and form, ripening to the stem. The plant is open, good size." "Fruit large but irregular." "The plant is very large and productive and the fruit is nearly uniform in size; a palatable flavor." "Tomato is large." "This tomato is excellent for the table. Fruit generally uniform in size and color. Number of fruits to a vine 22 to 30. This tomato is very fleshy and full and very good flavor." "They are a vigorous grower and the present indications are that they will yield about with the "Stone." "In quality my wife says they are just grand." "Vines vigorous, good-sized fruits. An excellent pink sort, solid, like 'Ponderosa,' but smooth and, therefore, a great improvement over the latter. Prolific, as I counted as high as seven good-sized tomatoes in a single cluster." "Size medium, plant vigorous and productive, shape good, color bright red, uniformly good." "Tomatoes vigorous, medium size and very solid. The best feature of this tomato I consider is its solidity." "Tomatoes are nice and smooth, good bearers." "The vines are strong and healthy and have a fair set of fruit." "Very productive and the best flavor and sweetest tomato I have ever had." "The 'Magnerosa' tomato is all right; very productive, good size and smooth and very highly colored; plant made a vigorous growth during a dry season."

Reports from Testers for "Marvelosa" Tomato.

"Plants are very large and are full of green fruit. Good shape." "Notwithstanding the very dry season they have made vigorous growth, and are of good size, foliage of rich color." "The plants were good size and growth. Fruit quite uniform and very solid." "In spite of the unfavorable season, tomato vines seem quite vigorous." "This is better than its 'Ponderosa' parent, is a better shape, ripens to stem end, is very prolific, no acid, and is fine in every way." "The 'Marvelosa' tomato is a fine color." "Very satisfactory, making rapid growth and setting plenty of fruit to each vine, medium size, varying little in size on all vines planted." "Plant vigorous and prolific." "Plants strong and thrifty, bear well, fruit mostly regular in shape and solid with very little core. Has stood the dry weather better than other kinds, not showing any tendency to rot as other kinds have done." "The plant entirely covers the ground, planted four by four feet. Most of the plants have very large tomatoes, mostly red, with an occasional pink, the quality is very good and quite productive." "A good yielder, better than 'Magnerosa.'" "Tomatoes have been of good size, light red in color, solid meat." "Plants are large and vigorous, very productive, fruit large." "Very good scarlet sort. The small to medium-sized fruits smooth and handsome. Vines very vigorous, good yielder." "These tomatoes show an excellent growth, the plant does not spread out much, but has a good stalk and is very prolific." "Am well pleased with this. Plants vigorous. Trained to two stems, now four to five feet tall. Foliage abundant, healthy. Fruits large, regular, smooth, well-formed, meaty, bright red. No rot and but little cracking. Vines are bearing wonderfully. I never saw anything like it before in yield and average size of fruit." "Plants vigorous. Fruit smooth and round." "This tomato is very fleshy, best of flavor, very few seeds, plant strong, vigorous growth, beautiful color, a good bearer, solid and delicious fruit. Am more than pleased." "Fruit is of good size and shape and has a very fine flavor. Some specimens have a green core in interior. Vines are very productive and of large size, with heavy foliage." "Plants vigorous and well filled with fruit of good shape." "Very good, solid and good flavor. Color pink, medium early, smooth and fair size, very prolific." "The tomatoes are very fine." "Good growing plants. Desirable." "Plant large, grows three to four feet long without support. Productive. First fruits very large and not very smooth. Some nearly six inches across. Bulk of the fruit large, uniform, smooth and colors all over a bright red. Very solid and of excellent quality. Ripens quite as soon as the 'Stone.'" "Tomatoes very fine, strong and vigorous vines, well set with fruit. A very desirable tomato." "Plants are large and vigorous. Color of fruit a bright red, meaty, and of excellent quality." "Medium size, shape almost round, very handsome medium plant and producer." "Large size, some weighing a pound each. Plants thrifty growers." "Tomatoes from this seed were highly satisfactory. Good shape, no core or hard part, color and size good." "Very productive and bore good, firm tomatoes of medium size." "All plants were thrifty. Some gave us very large plants and fruit; very solid and perfectly smooth and of extra fine eating quality." "Healthy foliage, prolific bearer, having two kinds of fruit—a large red on most plants and a small pink on a few others. Quality very good."

Reports from Testers for "Crimson Cushion-Marvel" Tomato.

"An excellent table variety." "This tomato cross will no doubt be a fine tomato. Its vines are fairly vigorous, fruits, in cluster three to five, good size, shape and uniform." "Plants large, vigorous, very shapely, productive, fruit medium in size, very meaty, deep pink in color." "A fine variety, large, vigorous growth, very productive. Fruit, medium to large and solid, very uniform, rich red." "Vines vigorous, good shape." "This is a gem; about the finest tomato I ever grew. Very vigorous, long prolific bearer of good-sized, unusually smooth, solid fruits. It will be hard to beat." "Vines healthy looking." "Part of plants potato leaf, and part regular tomato foliage. Plants with regular tomato foliage, large and vigorous. Plants with potato leaf a rank grower, but not as large and more upright. Fruit medium in size, very solid, nearly round and perfectly smooth, with but very little acid; the sweetest I ever tasted; all of same shape and size." "Vines very thrifty, fruit fair size." "Plants vigorous growers, foliage healthy." "Large, vigorous plants, and fruits round, uniform and of a fine scarlet in color." "Fruits smooth, uniform, medium size, good quality, resembling 'Crimson Cushion' tomato, good bearer, an excellent general purpose tomato." "The tomatoes were large and the bushes were very productive." "Fair sized plant; some fruits were large, color red, extraordinarily prolific." "Bore well and fairly good quality."

The Interior of the Tomato.

The interior of a tomato fruit as here considered embraces all within the skin and may be divided into (1) the flesh, (2) pulp, and (3) seeds. Under the first heading is included (a) the rind, or covering outside of the seed cavities (locules), (b) the par-

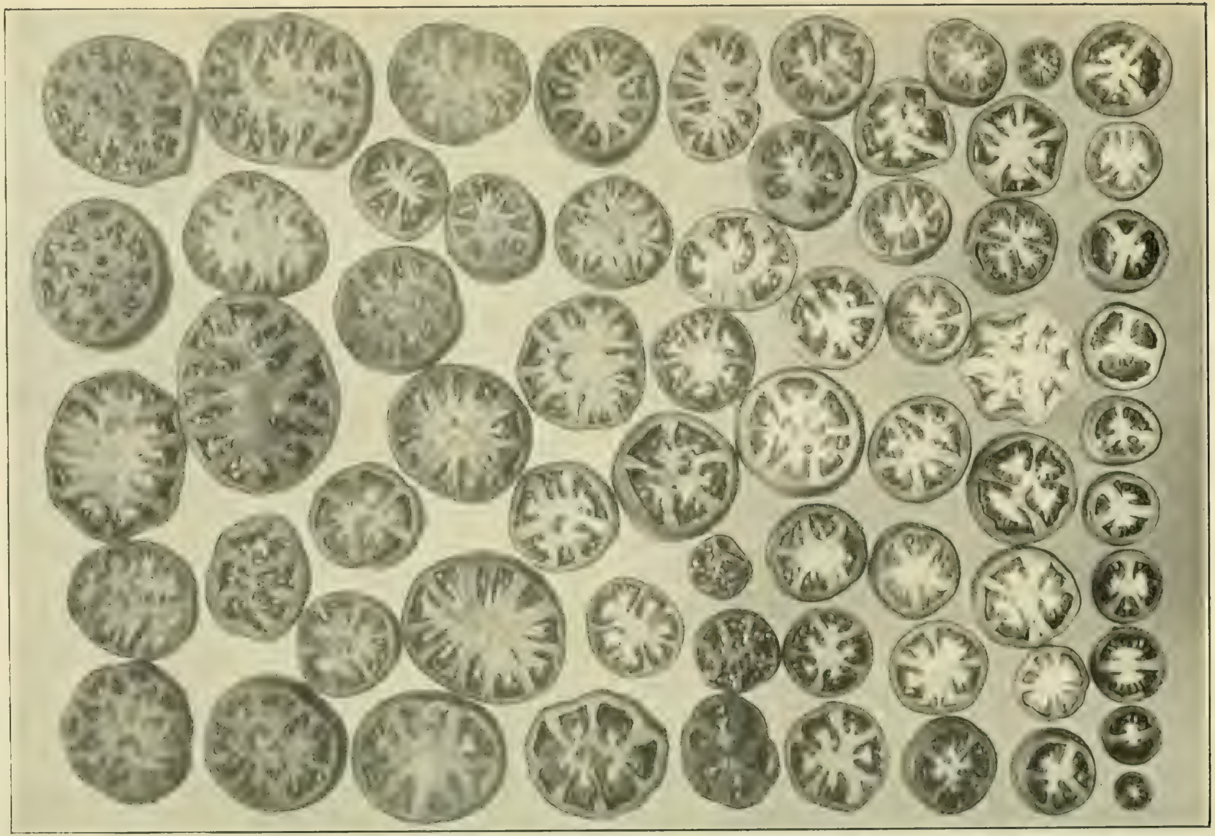

Plate X. *Sections of Tomato Fruits.* A group of fruits in section through equatorial diameter, showing something of the probable stages in the development of the fruits upon the left from those shown upon the right hand.

titions between the locules, (c) the connections between the latter and the seeds, botanically known as the placentæ. The second primary group is well defined and does not admit of further division, but is subject to remarkable variations in the evolution of the modern, highly modified fruits. This pulp is the soft part that surrounds the seeds and may be easily squeezed out of the locules along with their contents, namely, the seeds which constitute the third main division of the fruit.

The rind, the division walls and the placentae, taken collectively as the flesh of the tomato, is the portion sought for by the housewife. A chief difference between the solid and desirable fruit and the flabby one is the large percentage of the flesh. Compare, for example, the fruits as shown in slice view in the row at the right and the one at the left in Plate X.; the latter are, of course, of larger size, and represent the type that is sought for in present-day tomatoes. Instead of the two or three large locules that are characteristic, presumably, of the fruits of the species in its wild state, the seed-cavities are numerous, each one comparatively small, and surrounded with thick, firm partitions, bearing uniformly the rich color of the variety, and having no hard green central core so often met with in the older types of tomatoes. The beauty of the slices of the highly-bred fruits, as they are served, bespeak a great future for this modern accession to the vegetable garden. A large slice, displaying sufficient firmness to handle well, with its highly-colored flesh free from all semblance of hard, green spots, and interspersed throughout from center to circumference with many small locules, each with one or but few seeds, is an object that is tempting in the extreme. Should some of the slices be cherry red, and others orange-yellow, and distinguishable in the high flavor of their contents, the dish becomes all the more attractive. The subject deserves the use of colored plates to do feeble justice to the richness of hues of these high reaches of the art of the tomato breeder.

But it is not only the contents of the fruits that are in contrast between the samples upon the extreme right and left hand in the plate. It goes without saying that here, as elsewhere, there is a size below which it is not acceptable, and the universal verdict upon many present varieties is their smallness. The error may be in the opposite extreme, and the kind is rejected because of its over-sized fruits. These objectionable extremes have been kept in mind, and the giant and the dwarf in fruit are interesting, chiefly as marking the range. Therefore, into the set of slices shown, none of the very largest have been introduced, and samples of the "Currant" are likewise lacking.

Beginning upon the outside, the first subject for consideration is the skin. Ordinarily, this is a tough layer of tissue that serves well the purpose of protecting the tender inner parts from the many enemies from without. A defect here is in its tendency to crack, which frequently should not be ascribed so much to the skin as the flesh beneath, as it is due largely to an unevenness in ripening. This is often met with in the early, flat form of fruit, where the shoulder or stem end of the fruit is the last to remain green, and cracks occur in the flesh between the ripe and ripening portion, and often in somewhat concentric lines as the maturing progresses. At the blossom end, the skin often is poorly backed up by a good rind, and breaks occur and decay ensues. Fruits with a smooth blossom end, and well supplied with a thick rind, are the least liable to "go down." The tomato fruit is quite susceptible to influence from the weather, and, during a wet spell, are apt to fill with water, and, if the skin is too weak, the fruit cracks and is soon worthless. For this reason, a firm skin and rind is desirable, and such quality helps to exclude the germs that seem ever ready to attack the fruits. As ordinarily the skin is removed before the fruit is served, any addition to its firmness may not prove objectionable, and some attention might well be paid to this side of the question of improved tomatoes by the breeder.

When it comes to the rind, the next subject to command attention in passing inward from the skin, it is evident that firmness here must not go beyond a well-established limit. Above all things, it must be edible, and to this end consistency and flavor are nearly everything. The flesh of the outer wall, in other words, needs to be uniformly fine in texture and color, and thickness here is perhaps a leading desideratum. If the wall is thick and sufficiently firm (within the limit of tenderness), the fruit will present a uniform surface upon the outside, provided the locules are many and, therefore, small. A large "pear" (even though the wall is quite thick, but having but two seed-cavities) will be pressed out of shape in the basket, and when the rind is thin, as is usually the case, the fruit is flabby while still upon the plant. There is much to be done in improving the rind among standard sorts of tomatoes. As the eye runs over the display of slices in the Plate, several fruits are seen that have the rind so thin that the tomato—still green, as all the fruits were purposely immature when used for the photograph—is more or less corrugated. "Rough," or angular tomatoes, as a rule are defective in this respect because of a lack of a proper thickness and texture of rind.

The partitions (dissepiments) between the locules are not as a rule all that one desires. To say that they ought to agree in texture, thickness and color with those qualities of the outer wall is to very closely cover the desired points. In the old type of fruits, shown upon the left hand of the Plate, the partitions, although very limited in number, are of good thickness for fruits with many seed-cavities, but they make up only a small percentage of the contents of the tomatoes, having only two or three locules. The fruits upon the right indicate that, so far as the partitions are concerned, they are approaching the ideal.

A consideration of the walls of the fruit, in a certain sense, disposes of that of the pulp and seeds, for when the flesh is developed to its desired amount, the locules will be necessarily many and small. In the evolution of the tomato fruit, there was the increase in size, accompanied with that of the number of the partitions, thus adding to the locules. The seeds decreased relatively, but not absolutely. A large "Ponderosa" fruit has many times less seeds per pound of flesh than the "Currant" or "Cherry," but of course many more than any one of these small tomatoes. After the locules reached five or six, there comes a broadening of the fruit, the core being more prominent than before. Several such fruits are shown; while the size was augmented, the roughness of the exterior increased, and also a corresponding amount of waste.

Perhaps the most desirable advance was made when the core became broken and the seed-cavities were not all arranged around or along a common center. The reader may be rewarded in a search for the slices in which there is no distinct core, but, instead, one or more locules in the center of the fruit. Once this important end was reached in the development of the tomato, the way became clear for the development of fruits in which the core, as such, does not exist and flesh and locules are interspersed as shown in the slices at the right hand of the Plate. The reader must not conclude that any one fruit is the type of all the others upon the same plant. This may be true for the old-time and simple types but the highly developed modern kinds will require much further attention before that desired end is reached.

A Preliminary Classification for Tomatoes.

There are certain characters among tomatoes that are not easily disturbed in the breeding of widely different sorts, and from their behavior may be considered Mendelian. Thus, as regards the whole plant, there are two types, namely, the "standard" and the "dwarf" and when these two are united the offspring in the first generation after the blend show one-quarter of the dwarf type. Again, should a fine-leaved and a coarse-("potato")-leaved variety be bred together the result is a quarter of the coarse-leaved plants following immediately upon the blend generation. In one set of crosses (the "Dwarf Champion" upon "Magnus") where the two characters above considered are involved the following results were obtained:

Standard,	fine-leaved	plants,	49;	theoretical,	45.
"	coarse-leaved	"	16;	"	15.
Dwarf,	fine-leaved	"	13;	"	15.
"	coarse-leaved	"	7;	"	5.

In this instance, the "Champion" was "fine-leaved" and "dwarf," that is, of the two unit characters (*una*) in question one was dominant, namely, the foliage type and the other, the size of the plant, was recessive, that is, excluded when its antagonistic character, the large type of plant, is present. In a similar manner, the "Magnus" carries a recessive character (the coarse foliage) and a dominant one as to its size of plant.

There are two types of foliage as to its color, namely, the ordinary green, which seems to be a dominant character, and a peculiar sickly yellow that conforms to the Mendelian law so far as this type of tomato foliage has been studied by the writer. As each of these antagonistic, or mutually exclusive, characters act independently, it is found that when three sets are involved as (1) size of plant, (2) shape of leaf and (3) color of foliage, the theoretical numbers will be as follows:

Standard,	fine-leaved,	green	foliage,	27
“	“ “	yellow	“	9
“	coarse-leaved,	green	“	9
“	“ “	yellow	“	3
Dwarf,	fine-leaved,	green	“	9
“	“ “	yellow	“	3
“	coarse-leaved,	green	“	3
“	“ “	yellow	“	1
				64

The practical test of this theoretical table in its entirety for tomatoes has not been made by the writer but opportunity may offer in the near future.

Turning now to the color of the fruits there are at least three una that may be considered, namely, the "red," the "pink" and the "yellow," all three of which are far from true to the popular names given to them, for the "red" is more orange than red, the "pinks" about midway between orange and red, while the "yellows" contain much orange, but for the present purpose they may be treated as distinct colors in reference to tomatoes.

It is found that when the "red" and "yellow" are bred together the red is dominant and, as a result, the number of yellow-fruited plants in the first generation after the blend approximates 25 per cent. The same result obtains when "pink" replaces the "red" in the above cross, thus showing that the "yellow" is recessive to both the "red" and "pink." When the "red" and "pink" are bred together, the results have not been so sharply defined, that is, the "red" is less evidently the dominant and with this set of crosses more study is desired.

To this list of una, it is probable that further study will demonstrate that the smoothness and the hairiness of the fruit may be added, that is, in the various crosses with the "peach" tomato the fuzz of the latter kind appeared in numbers to suggest that it is a recessive unum.

It is too soon to decide how much weight should be placed upon mere size of fruit as a unum. It is probably true, however, that two general sizes may be employed as a final factor in a scheme of classification that is here offered:

- A. Standard.
  - B. Fine leaved.
    - C. Green foliage.
      - D. Red fruit.
        - E. Smooth fruit.
          - F. Large fruit.
          - F. F. Small fruit.
        - E. E. Hairy fruit.
      - D. D. Yellow fruit.
      - D. D. D. Pink fruit.
    - C. C. Yellow foliage.
  - B. B. Coarse leaved.
- A. A. Dwarf.

In the above scheme, the six chief points are given only for the first head under each division, thus, the same sub-divisions obtain for "dwarf" as for "standard," for "coarse"-leaf as for "fine" leaf, etc. In other words, for example, there are red-fruited varieties, theoretically at least, for both "green" and "yellow" foliage, of both "fine" and "coarse"-leaved, and of both "standard" and "dwarf" plants.

Many of the standard varieties could be arranged under this scheme, but for some of the headings the representatives are lacking. This is particularly true of the yellow foliage (subdivision C. C.) and the hairy fruit (E. E.), but should one desire to do so, the way is clear for filling up the deficiencies in the scheme, but usually they would result in plants and products that would not appeal to the practical tomato grower; thus, one might make a dwarf, coarse-leaved, yellow-foliaged and yellow-fruited, hairy tomato of small size that, while interesting as a novel combination of qualities, would not be sought for as a big seller.

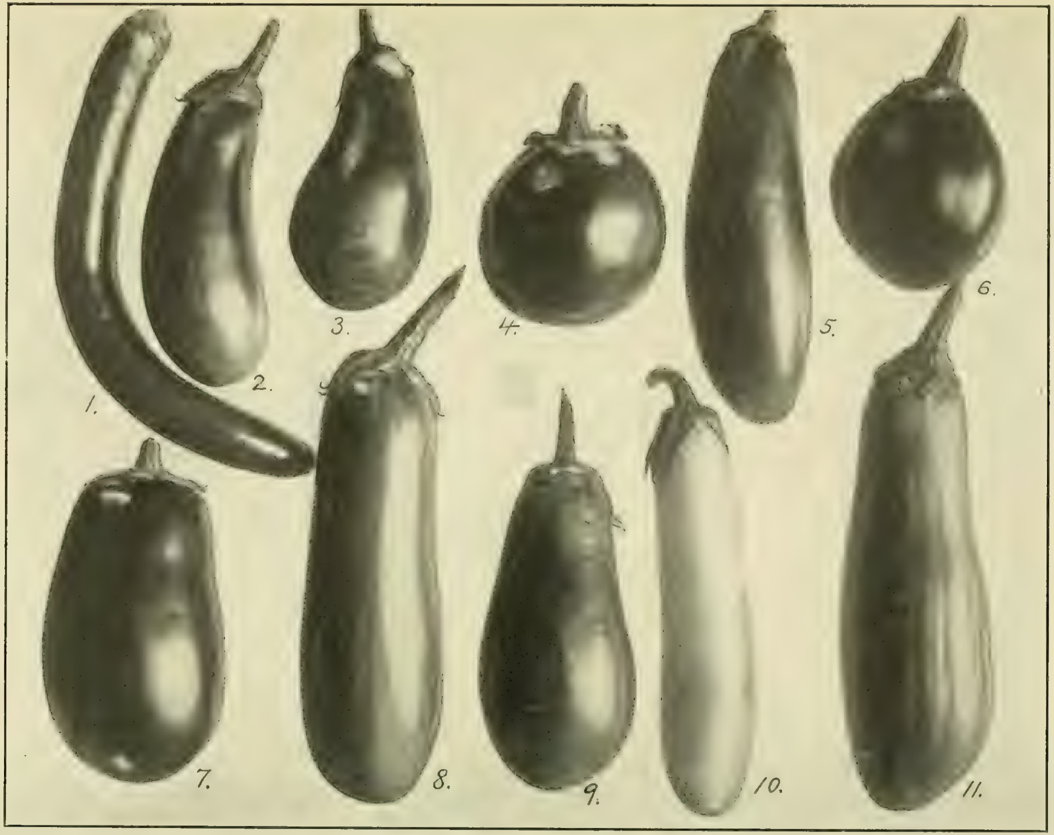

PLATE XI. *Eggplant Crosses.* The parents are as follows: 1, "Black Snake;" 3, "Dwarf Purple;" 4, "Pekin;" 7, "Jersey Belle;" 10, "Long White," and the blends located near parents at 2, 5, 6, 8, 9 and 11.

EXPERIMENTS WITH EGGPLANTS.

A somewhat larger space than usual was given upon the Home Grounds to the experiments with eggplants. This was due to the long list of crosses under consideration, and the continuation of the work with the hybrids between the "American" and "Chinese" species that rapidly expands with the years. Only one commercial variety was added to the list, namely: "Round White," which takes the record number 29 in the many crosses that appear successful with it.

A Study of Blend Fruits in Eggplants.

The blend plants of the several crosses of eggplants have shown remarkable uniformity; thus, two rows of these were in quite striking contrast with those alongside of the first generation after the blend. This is as one expects after some experience in the breeding of plants, but perhaps nowhere else in the truck garden is this better illustrated. By crossing two dissimilar types, for example the "Black Snake" and "Dwarf Purple," the former a tall standard and the latter a true dwarf, a uniform set of semi-dwarfs is obtained that blooms profusely and bears an abundance of fruit. A fruit of the "Black Snake" is given at 1 in Plate XI., and is seen to be long, slender and bent (often to more than a right angle). This kind is too small for practical purposes, and the plants are not sufficiently productive to make them worthy of a place in the home garden, except as a curiosity. The "Dwarf Purple" fruit is shown at 3, and is an early sort, but the fruits are too small for market purposes. At 2 is shown a sample fruit of the blend, which is a thorough union of those next to it. Thus, the "Black Snake" is practically spineless, has a calyx that is green, tinged with purple, and the fruit flesh beneath it is a pale green, the body of the "egg" being purplish green, somewhat striped, while the "Dwarf Purple" has a solid dark, almost velvety, purple upon the fruit, calyx and stem, but is nearly white beneath the calyx; this is shown in the plate as one of the calyx lobes was removed just before the picture was taken. The blend fruit is decidedly curved, but not as much so as the male parent; the color is a combination of the two parents, thus giving an indistinct showing of stripes in which green plays a much disguised part, while the calyx is like the "Black Snake" in some features, but of a purple approaching the mother. The color of the fruit under the calyx is less white than the one and more green than the other parent. These items are dwelt upon to impress the fact that the union of two dissimilar sorts in its first offspring, the blend, is an almost amusing reflection of both parents, the analogue of which is seen in the blending met with in human families.

At 4 is a small fruit of the "Black Pekin," characterized by being practically round, of a dark purple, and, like the "Dwarf Purple," nearly white beneath the calyx lobes, as indicated in the engraving. The plants are tall and purple in stem and leaf. When this variety is bred to the "Black Snake," the first season shows plants of great uniformity and fruits, as at 5. This fruit is nearly straight, and of considerable length and size, showing that from the economic standpoint this cross may exceed in value the one that was last considered. As the parents are both tall and slender, the offspring is likewise of the same class, holding its long pendent fruits often a foot above the ground, which is a desirable feature when the matter of decay is considered. The markings of this blend are all a union of those of the parents, with the addition that the first year is characterized by a profuse bloom and a large yield of fruits.

The fruit at 6 is from a blend plant of the "Black Pekin" upon "Dwarf Purple," that is, a combination of those whose fruits are shown at 4 and 3—the male being given first as always in mentioning a cross. Here the great differences are in the plants themselves, for one is a tall type and the other a dwarf and, as a result, a medium-sized plant is obtained of considerable merit. The fruit is neither a sphere as in the "Black Pekin" nor a long "pear" produced by the "Dwarf Purple," but is somewhat oval and not handsome with a stem that is as stout as that of the "Pekin."

At 7 is shown a small sample of the "Jersey Belle," a variety produced some years since by breeding together the "Long Purple" and the New York Improved," and is here introduced as a parent in a cross upon the "Black Snake" shown at 8. This combination results in a medium tall plant with a blending of the qualities of the two parents as fully in all respects as they are shown for the fruit. Bear in mind that the two end fruits, one over the other, are the parent types of the one shown at 8. The curvature of the "Black Snake" has been extracted entirely in the instance illustrated but some of the fruits show a bend that might be expected. In the blend fruit there is to be seen both the fine purple of the "Jersey Belle" and the obscure green striping of the "Black Snake." This is shown in the photograph (lost in the engraving) and is highly interesting to the breeder but possibly might be objected to by the judge of vegetables at the horticultural shows. For the home garden, this cross is recommended because it is prolific, the plants are tall and the fruits are held up from the soil; it is practically spineless and the shape and size are very desirable for economic handling and preparation for and serving at the table.

The "Jersey Belle" upon "Dwarf Purple" blend fruit is shown at 9, and here again the greater differences are in the plants themselves, for one parent is a medium tall type and the other a dwarf. The fruit is of a larger size than the "Dwarf Purple" and usually without the curve that is often seen in the parent. An interesting blend of characters is seen in the color of the fruit flesh beneath the calyx; in the "Jersey Belle," the color is practically the same all over the fruit clear up to the insertion of the stem, while, as pointed out before, that of the "Dwarf Purple" beneath the calyx is white. In the blend the color is a light pink as is indicated in the photograph for the portion exposed by the removal of the calyx lobe. It may be added here that when the fruit surface is exposed, as in these instances, the color soon develops there as elsewhere on the fruit.

At 10 is shown a specimen fruit of the "Long White"; this is a slender, nearly straight fruit with a pale green color and is introduced here as one of the parents of the blend fruit shown at 11, namely, "Long White" upon "Black Snake." It is interesting as being an instance where the combination increases the size, but probably the fruit shown is above the average in bulk. Both the parents are long and the blend is somewhat midway, but the surface coloring is a close reproduction of the "Black Snake," as the other parent has no color value to change it in the blend but in the next generation one-quarter will probably be white.

"Long White" Upon "New York Improved" (11/18).

The above-named cross has proved to be unusually attractive and now, five years after it was made, the results warrant offering the seeds of two selections from this one combination under special names for further trials by those who may wish to grow them.

The "Ivory."

The male parent in this cross is a variety with plants of medium size, having green stems and leaves and the flowers showing only a small amount of the purple common to the ordinary sorts, while the fruits are long, slender, somewhat curved and of a greenish white color. Upon the other hand, the female parent belongs to the group of "medium tall' varieties with dark stems and foliage and large, oval, purple fruits.

The blend plants of the cross, grown direct from the seed from the fruit resulting from the hand-worked flower, gave a uniform lot of plants in which the color of the mother was dominant in plant and fruit. Seed from these plants, fertilized by hand within the cross, gave a mixed lot of plants, some of which were smaller than others and the stems and leaves of a quarter of them were lacking in the purple color and produced pale flowers and white fruits. In shape they were, however, a blend between the two sizes and shapes of the parents and lost the objectionable green of the male parent.

By breeding the white strain within itself, it was at once free from the purple of the "New York Improved" and, through isolation and selection, there has been developed a block of plants from twelve of which the present season samples are shown in Plate XII. These plants are productive, as a photograph of a single plant with twelve fruits, taken early in October, will bear

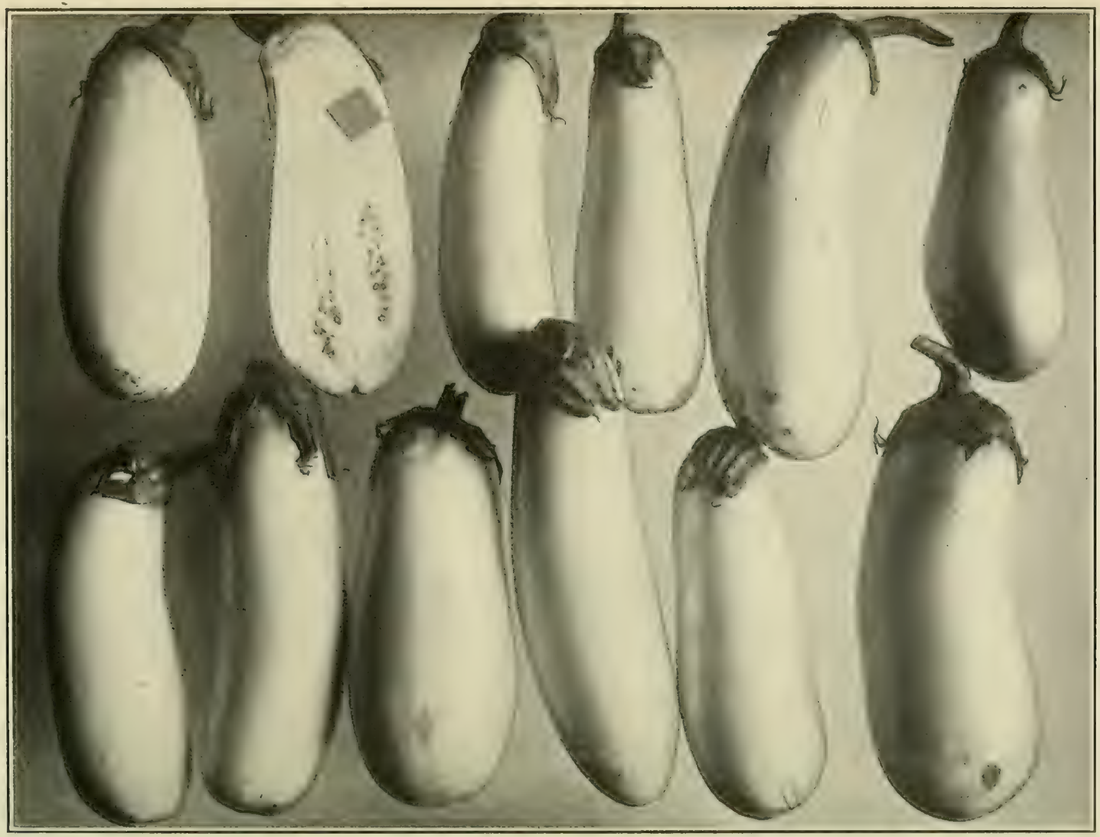

PLATE XII. *The "Ivory."* This new white variety resulted from the breeding of "Long White" upon "New York Improved." (11/18.)

testimony. The shape is all that can be desired, for they are convenient to handle in the market, are desired by the housewife for the convenient size for slicing, both for cooking and serving upon the table. The seeds are in the lower half of the fruit, as shown by the sample that is cut lengthwise and bearing a light gray paper an inch square to indicate the size of the fruit and the whiteness of the interior. If there is an objection to this fruit, it is in the absence of color to the exterior, which is so clear a white as not to be adequately described in this respect by the name "Ivory" that has been given to it. All who have had an opportunity to test the quality of this vegetable fruit are highly pleased with it and, aside from its desirable size and shape and pure whiteness, remarks most encouraging of the flesh, which shows its fine light color even after it reaches the table, have been freely offered.

The "Jersey Pink."

A few words will suffice for this variety for, in giving the origin of the "Ivory," that of the "Jersey Pink" is necessarily included, for both are alike in parentage and differ practically only in the color of the fruit, and that of the plant stems and leaves. At the time when the fruits are ready for market, the color is a rich pink but as they mature this is diminished somewhat.

In this variety there will be a small percentage of plants with white fruits but the practical grower may discard these as soon as observed. Theoretically, certain plants have none of the white blood and these, if isolated, would breed true, that is, produce no white offspring but as in similar cases the separation is not an easy matter all at once save by isolation or hand pollination.

The "Jersey Pink," to a very limited extent, was distributed to growers under the name of "Station Eggplant No. 2." This season adds emphasis to the footnote made in the report for last season that eggplant seedlings are not easy to grow.

Reports from Testers for the "Jersey Pink."

"Eggplants fair growth, quite productive." "Plants are larger and less subject to blight than those of 'Black Beauty' in the next row, and are also more productive and earlier. The fruits are long, mostly purple, a few white ones, all very good quality." "The plants are growing very nicely and the fruit is just developing, one is about five inches long. I think there will be a great many." "The plants are about two and a half feet high, very vigorous and productive, and full of blossoms, the fruit is mostly pink, some are white, long and of a nice size. The quality is of the best and when known well will be much sought for." "Strong, vigorous growth, and look very fine." "Best plant has seven fruits set; shape, uniform; quality, first class, plants have grown nicely since it has been warm enough. Have cut seven large enough to eat. Think it very promising for home use or for discriminating buyers of fancy fruits." "Good-sized plants, rapid growers, good bearers." "Good grower and productive." "The eggplants were very large; the fruit was long and thin." "Quality excellent; it is a large job for the good wife to fry enough to satisfy my appetite. Never had so many eggs before; twelve on one plant, all oblong." "The eggplant was of two colors; purple and white, but no difference in the taste, both were very toothsome and I consider it grew very well for me."

Hybrid Eggplants.

Plate XIII. shows a set of fruits gathered singly, or a cluster from each plant, thus representing fourteen individuals and nearly as many types of fruits. A sample fruit of the male parent of the union, namely, the common "American" eggplant is shown at the left hand upper corner (1) and the "Chinese" species, upon which it was worked in 1904, is shown in the opposite corner (16) of the plate. In 1905, the single blend plant was grown and the following is taken from the report for that year: "In a few words, this hybrid shows remarkable vigor, growing to perhaps three times the size of its parents, with a great tendency to produce blooms, which quickly fall away. It behaved like a perennial and did not find time in an unusually long season to mature more than two dozen fruits."

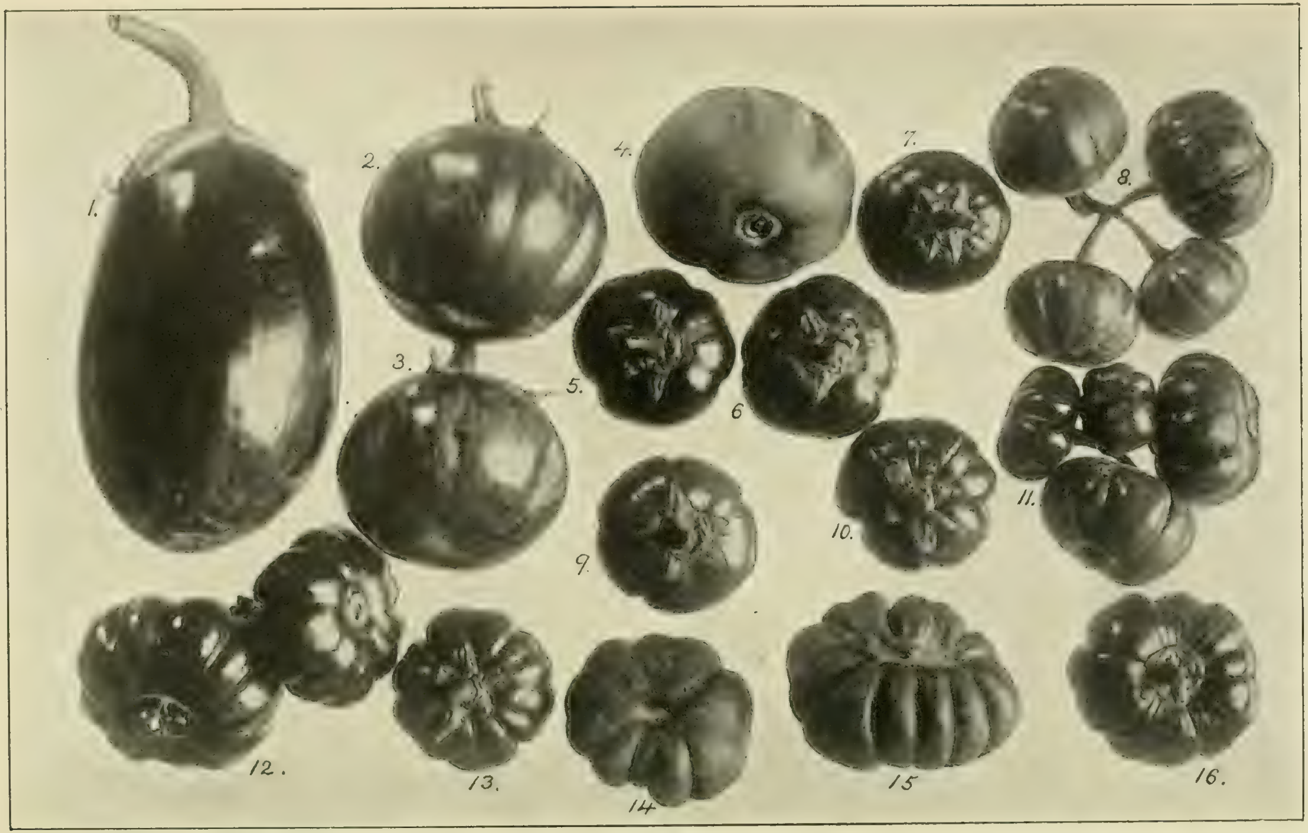
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Plate XIII. *Hybrid Eggplants.* Fruits from plants of second generation from the blend of "Fordhook" upon "Scarlet Chinese" eggplants, with parent types at 1 and 16.

In 1906 thirty-six plants, representing the first generation from the blend, were grown in the Home Grounds, a record of which (in tabular form) was given and the following statement made: "It is, however, apparent that regarding the character of the fruit, the 'Chinese' exerts a preponderating influence over the 'American,' but it is to be remembered that the large size of the fruits of the latter is a cultural development, and, so far as affecting the hybrid, it may be that the small-fruited wild type might have been as effective."

In the crop for the present season, there is considerable range in the plants and their fruits, three of which resemble the "American" quite fully in foliage and the fruits of these are an advance toward the same desired end. Samples from three plants are shown at 2, 3 and 4, and it is seen that they are nearly smooth and of fair size. As a rule, the hybrid fruits are orange colored but the three in question are dark purple and closely resemble the ordinary fruits upon the surface. In the crosses between the hybrids and the "American" parent, it is hoped that a further progress may be made toward a fruit that will be of good keeping and table quality.

In the plate, the fruits are arranged somewhat in the order of their resemblance to the parent species, those of "Chinese" type bearing the higher numbers, but it is seen that they intergrade so thoroughly that such an arrangement is difficult. A statement of the qualities of the whole plant in each case is more to the point and it is given in the following table.

From the list of thirty-six plants of the hybrid "Fordhook" upon "Scarlet Chinese" (14/25), seeds from four plants, namely, Nos. 3, 13, 29 and 33 were selected and sets grown with the results as given upon page 322.

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
Mother plant 3.						
No. 1,	Medium,	Purple,	Small,	No,	None,*	28
" 2,	Medium.	Purple,	Large.	No,		4
" 3,	Medium,	Purple,			Purplish,	4
" 4,	Dwarf,	Purple,		No,	Purplish,	4
" 5,	Medium,	Purple,	"Oak,"	No,	Purplish,	27
" 6,	Tall,	Purple,		No,	Purplish,	0
" 7,	Medium,	Purple,	Wrinkled,	No,	None,	0
" 8,	Medium,	Purple,		No,	White,	9
" 9,	Dwarf,	Purple,		No,	None,	10
" 10,	Medium,	Green,	"Oak,"	No,	White,	0
Mother plant 13.						
No. 1,	Tall,	Purple,	Wrinkled,	No,	White,	5
" 2,	Medium,	Green,	Medium,	No,	None,	0
" 3,	Tall,	Purple,		No,	None,	21
" 4,	Tall,	Purple,	Wrinkled,		None,	9
" 5,	Dwarf,	Purple,	Large,	No,	None,	0
" 6,	Tall,	Purple,	Wrinkled,	No,	None,	11
" 7,	Tall,	Purple,	Med. wrink.,	No,	White,	35
" 8,	Tall,	Green,	Wrinkled,	No,	White,	0
" 9,	Dwarf,	Green,	Wrinkled,		None,	16
" 10,	Tall,	Purple,	Wrinkled,	No,	Purple,	25
" 11,	Medium,	Green,		No,	White,	11
Mother plant 29.						
No. 1,	Dwarf,	Purple,	Large,	No,	Purplish,	19
" 2,	Medium,	Purple,	"Oak,"	No,	White,	25
" 3,	Tall,	Purple,	Medium,	No,	Purplish,	0
" 4,	Dwarf,	Purple,	Medium,	No,	Purple,	0
" 5,	Dwarf,	Green,	"Oak,"	No,	White,	23
" 6,	Tall,	Purple,	"Oak,"	No,	White,	12
" 7,	Medium,	Green,	Medium,	No,	Purplish,	0
" 8,	Dwarf,	Purple,	Medium,	No,	None,	0
" 9,	Medium,	Purple,	Medium,	No,	White,	11
" 10,	Dwarf,	Purple,	Medium,	No,	None,	0
" 11,	Tall,	Green,	Wrinkled.	No,	White,	10
" 12,	Medium tall,	Purple,	Large,	No,	Purple,	21
" 13,	Medium,	Purple,	Medium,	Yes.		139
" 14,	Medium,	Purple,			Purplish,	10
" 15,	Medium,	Purple,	Medium,	No,	None,	0
" 16,	Tall,	Purple,	Medium,	Few,	Purple,	17
Mother plant 33.						
No. 1,	Medium,	Purple,	Medium,	Yes,	None,	75
" 2,	Dwarf,	Purple,	Small,	No,	None,	6
" 3,	Medium,	Purple,	Smooth,	Few,	Purple,	30
" 4,	Dwarf,	Green,	Medium,	Few,	None,	10
" 5,	Medium,	Green,	Wrinkled,	No,	White,	5
" 6,	Medium,	Green,		Yes,	White,	8
" 7,	Tall,	Green,	Medium,	Few,	None,	0
" 8,	Dwarf,	Green,	Small,	Yes,	None,	55

*No flowers were present at time observations were made, October 10th.

Plant 12 of the above series (from mother plant No. 29) was full of interest because of the acceptable spinelessness (which was absolute and not relative) of the plant in all its parts. The dark purple color prevailed in stem and foliage, making in this respect a plant closely akin to the "Black Snake" and the "Black Pekin" and their class. The flowers were produced in great abundance and were of good size and a rich light purple; they set well and the plant produced a dozen fruits that averaged ten ounces while as many more smaller ones were on the way to maturity when the October frosts brought an end to the life of the hybrid plant.

The fruits are a flat oval with very indistinct ribs and, when mature, of a color not easily described; for the upper end next to the calyx is a shade of purple with a suggestion of bronze, while the lower end is a true purple and the equatorial zone is a mixture of the shades of the two ends dove-tailed together and more or less mottled. In sectional view, the interior of the fruit resembles somewhat a large tomato with several seed cavities (locules) that, in themselves, are very irregular and partially divided and giving the impression of a large number of locules. The seeds are very few, thus furnishing a large percentage of pulp. When tasted raw, the flesh is bitter and indicates that much further breeding will be required before the ideal hybrid is secured, namely, one that is spineless, productive and the fruits of marketable size with a flesh that is desired for its palateableness. The firmness of flesh and its long-keeping quality are points already secured, to which may be added the other necessary characteristics of a plant to make it acceptable by the market gardener, as well as the amateur who enjoys novelties that are of worth.

A number of crosses upon this plant are in sight that will increase the percentage of the "American" parentage and probably bring out a diversity of form and color from which a choice may be made. The vicissitudes of plant breeding might make an interesting chapter were the full feeling of the breeder written into it. In the present case, the finest, largest and first fruit resulted from hand-working the flower with pollen from the "Ivory," but, just before the much cherished fruit was to be taken for seeding, was removed by someone whose precise interest in it may never be known; it probably became an extemporized foot-ball (of small size) to gratify the lust for plunder in an apparently growing class of the uncontrolled.

A Fruitful Dwarf Hybrid Eggplant.

The block of hybrid eggplants was as noticeable for the great range in fruitfulness as in any other character. A glance at the table will show that there is, in a general way, a correlation between the size of the plants and their fruitfulness. All the very tall, broad plants that towered above their fellows were, as a rule, nearly or quite barren, while, upon the other extreme, the low plants (underlings) and particularly those of medium size were fruitful. An illustration of the latter is given in Plate XIV., where the lower portion of the plant is seen to bear over fifty fruits. This plant grew by chance in the same hill with one that was fully four times its height and breadth but produced no ripe furits. These "giants" are, as a rule, free bloomers, but for reasons not yet fully understood the fruits fail to form. This is not unlike the condition obtaining with the blend plants of the hybrid in question, which the summer through are covered with hundreds of flowers, but fruits at the close of season are almost entirely absent.

"American-Chinese" Eggplants; Derivative Hybrids.

Last year, twenty-four plants of a derivative hybrid of the "American-Chinese" eggplant were grown, that is, a combination of the above hybrid crossed upon by the "Chinese" and expressed by the compound fraction 25//14/25. Seeds from five of these plants were used for the continuation of the hybrid upon the breeding grounds the present season, namely, Nos. 1, 5, 7, 10 and 14, and they have given a very diverse lot of plants as described in tabular form below:

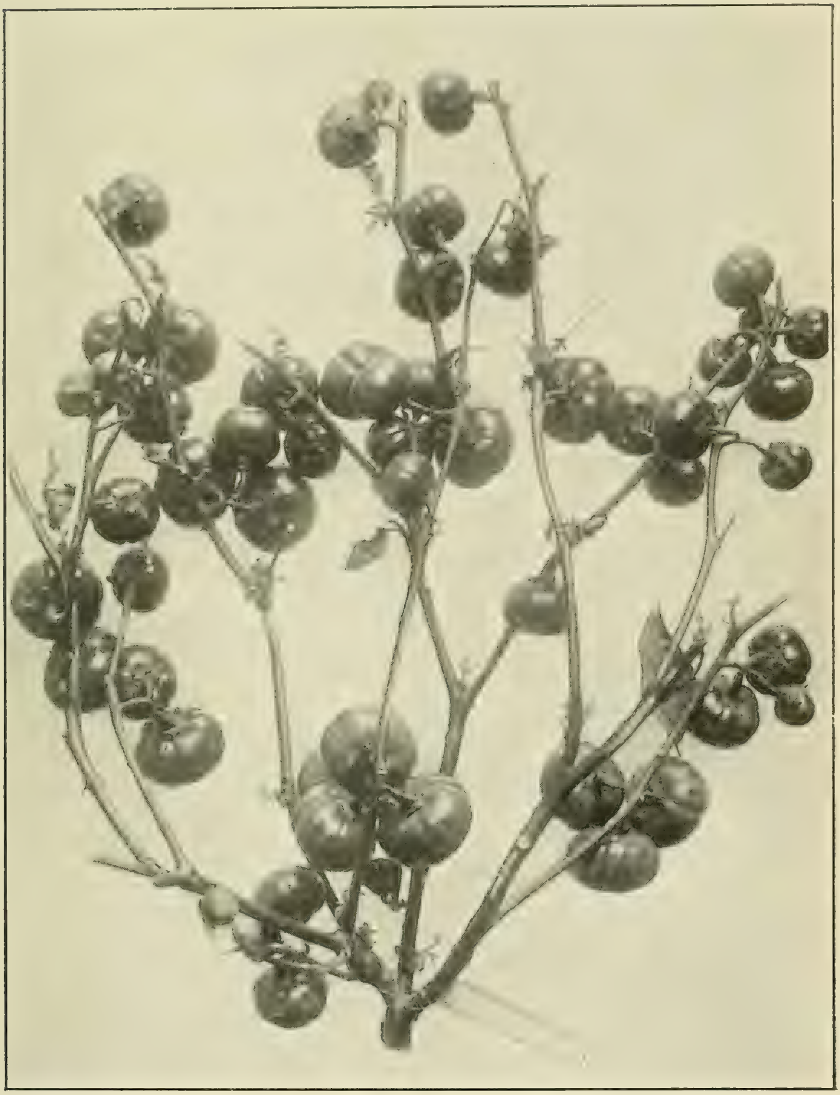

PLATE XIV. *A Fruitful Dwarf Hybrid Eggplant.* The stem was cut off close to the ground and the tips of the branches and many young fruits removed to accommodate the plant to the camera.

Mother plant 1 was medium-sized, with dark, smooth and purple foliage with no spines and bore 24 fruits.

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Dwarf,	Purple,	Sm. smooth,	No,	None,*	0
" 2,	Dwarf,	Purple,	Med. smooth,	Yes,	White,	67
" 3,	Tall,	Purple,	Med. smooth,	No,	White,	35
" 4,	Dwarf,	Purple,	Sm. smooth,	No,	Purple,	18
" 5,	Tall,	Purple,	Med. smooth,	No,	Purple,	55
" 6,	Tall,	Purple,	Wrinkled,	No,	Purple,	0
" 7,	Tall,	Purple,	Wrinkled,	No,	White,	0
" 8,	Medium,	Green,	Large,	No,	None,	3
" 9,	Tall,	Purple,	Lar. wrink.,	Yes,	White,	3
" 10,	Tall,	Green,	Med. wrink.,	No,	White,	0
" 11,	Medium,	Purple,	Med. smooth,	No,	White,	0
" 12,	Tall,	Purple,	Large,	No,	Purple,	17
" 13,	Dwarf,	Purple,	Med. smooth,	Yes,	White,	91

Mother plant 5 was medium-sized with stems green, foliage light green, spineless and bore 15 fruits.

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Tall,	Green,	Wrinkled,	Yes,	White,	87
" 2,	Tall,	Green,	Wrinkled,	Yes,	None,	0
" 3,	Tall,	Green,	Smooth,	Yes,	White,	3
" 4,	Dwarf,	Green,	Smooth,	Yes,	None,	0
" 5,	Dwarf,	Green,	Wrinkled,	Yes,	None,	0
" 6,	Dwarf,	Purple,	Wrinkled,	No,	Purple,	2
" 7,	Tall,	Green,	Smooth,	Yes,	White,	35
" 8,	Dwarf,	Green,	Smooth,	Yes,	None,	0

Mother plant 7 was low with purple stems and foliage, spiny and had 24 fruits.

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Tall,	Purple,	Smooth,	Yes,	Purple,	177
" 2,	Tall,	Purple,	Smooth,	Yes,	Purple,	67
" 3,	Dwarf,	Purple,	Smooth,	Yes,	Purple,	4
" 4,	Tall,	Purple,	Smooth,	Yes,	Purple,	58
" 5,	Tall,	Purple,	Smooth,	Yes,	White,	79
" 6,	Tall,	Purple,	Wrinkled,	No,	Purple,	46
" 7,	Dwarf,	Green,	Smooth,	No,	None,	13
" 8,	Medium,	Purple,	"Oak,"	No,	White,	4
" 9,	Tall,	Green,	Wrinkled,	Few,	Purplish,	25
" 10,	Tall,	Purple,	Smooth,	No,	White,	11

*No flowers were present at time observations were made, October 10th.

Mother plant 10 was a giant with purple stems and large leaves and few fruits.

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Medium,	Green,	Wrinkled,	Yes,	White,	24
" 2,	Tall,	Green,	Wrinkled,	Yes,	White,	1*
" 3,	Tall,	Green,	Wrinkled,	Yes,	White,	23
" 4,	Tall,	Green,	Wrinkled,	No,	White,	0
" 5,	Medium,	Green,	Wrinkled,	Yes,	None,	1*
" 6,	Tall,	Green,	Wrinkled,	Yes,	None,	0
" 7,	Medium,	Green,	Wrinkled,	Yes,	None,	31
" 8,	Medium,	Green,	Wrinkled,	Yes,	None,	11*

* Small.

Mother plant 14 was medium-sized with green stem and leaves, spiny and bore 27 fruits.

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Dwarf,	Green,	Wrinkled,	No,	None,	0
" 2,	Dwarf,	Green,	Smooth,	Yes,	None,	0
" 3,	Medium,	Green,	Wrinkled,	Yes,	None,	0
" 4,	Medium,	Green,	Wrinkled,	Yes,	None,	0
" 5,	Tall,	Purple,	Smooth,	Yes,	Purplish,	56
" 6,	Tall,	Green,	Wrinkled,	Yes,	None,	7
" 7,	Tall,	Purple,	Smooth,	Yes,	Purplish,	21
" 8,	Dwarf,	Green,	Smooth,	Yes,	None,	0

In fruit characteristics, there was considerable range; beyond the variations noted in previous years, some plants were with fruits of a decidedly yellow color, which is quite unusual and may throw some light upon the way such novelties come into existence. There was one plant that produced fruits that were russet-coated similar to this constant character in some varieties of apples. Perhaps the most striking of all the new shapes is the true egg form that is constant with a quite fruitful dwarf plant.

The Orange Oval Hybrid Eggplant.

In addition to being of a low, wide-spreading form as stated above, this plant bore an abundance of smooth, egg-shaped,

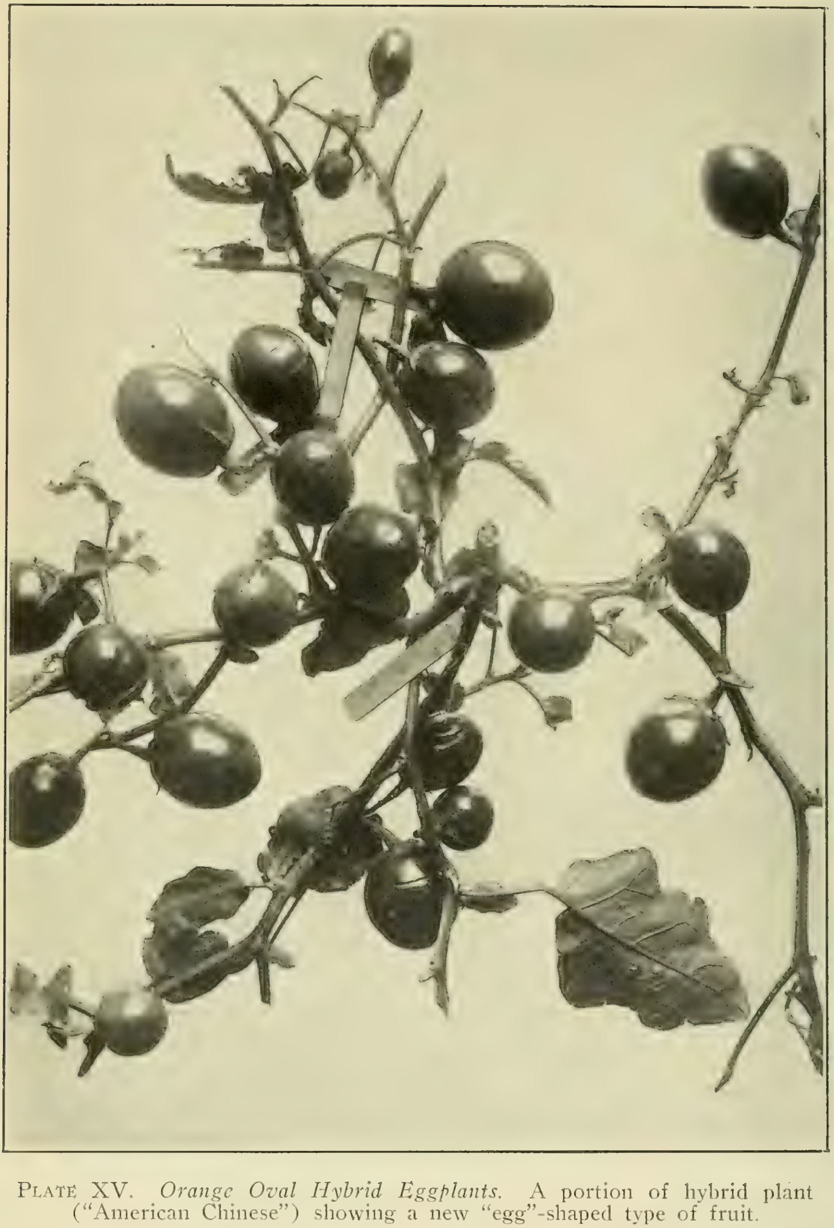

PLATE XV. *Orange Oval Hybrid Eggplants.* A portion of hybrid plant ("American Chinese") showing a new "egg"-shaped type of fruit.

orange-colored fruits, of quite a different type than had heretofore been obtained. The central portion of the plant with roots and short main stem removed, is shown bottom side up (for convenience in photographing) in Plate XV., the longer branches for half their length having been cut away, together with a large number of the smaller fruits. The calyx, stem and leaves are absolutely spineless, which is one of the important results of the breeding together of the two species, both of which abound generally in the undesirable prickles.

With this plant, the "Ivory" and the "Round White" have been bred with the hope of gaining size in the fruit and retaining somewhat of the firmness of the flesh so that long shipment may be made with safety.

"Pepper-leaved" Hybrid Eggplant.

Another plant of the 25//14/25 set, grown the present season, has shown remarkable deviation from the average by being quite small and low, not of the strictly dwarf type as that term is understood when used with peas, beans, and tomatoes. The plant in question is very slender in stem and the leaves are thin, smooth, dark green and nearly entire, thus giving the foliage much the appearance of the garden red pepper (*Capsicum annuum*), to which it is not distantly related botanically. The fruits are medium-sized for this generation of the hybrid, flatish, slightly corrugated and of a pale yellow color, the last characteristic being quite in contrast with the prevailing deep orange of the other associated plants. There being an entire absence of prickles makes this plant still more desirable as the starting point for future breeding.

"Dwarf Purple" and "Chinese" Eggplant Hybrids.

The "Dwarf Purple" and "Chinese" eggplant reciprocal hybrids have been grown the present season in both the blend and the first generation thereafter. The blend plants of the "Dwarf Purples" upon "Chinese" (6/25) made a row of plants very uniform in size, midway between that of the two parents, and bloomed abundantly. There was some variation among the plants in the number of spines, which were as a rule long and stiff. The fruits were very scarce, there being 55 for twelve plants, including one barren plant.

In the reciprocal (25/6), the record shows that the row of plants was uniform with the above and, at a short distance, the two rows could not be distinguished as to size of plants, bushy habit, fine purple foliage and profusion of blossoms. There were some barren plants, the total crop of fruits being 35 from twelve plants.

In the first generation from the blend, the 6/25–I. showed great variation in many respects; in size of plant, some were tall, others truly dwarf, some had fine foliage and others bore large leaves, and in the matter of spines there were all gradations from perfectly smooth plants to those that had very many long stiff spines. Notes upon some points are lacking in the table below:

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Medium,	Purple,	Smooth,	Yes,	Purplish,	7
" 2,	Tall,	Purple,		Yes,	Purple,	35
" 3,	Tall,	Purple,		Yes,	Purple,	19
" 4,	Tall,	Purple,		Yes,		41
" 5,	Tall,	Purple,		Yes,	Purple,	71
" 6,	Dwarf,	Green,	Small,			37
" 7,	Dwarf,	Purple,		Yes,	Purple,	51
" 8,	Dwarf,	Purple,	Small,		Purple,	29
" 9,	Medium,	Green,		Yes,	White,	0
" 10,	Tall,	Purple,	Large,	Yes,	Purple,	6
" 11,	Dwarf,	Purple,		Yes,	Purple,	11
" 12,	Medium,	Green,	"Oak,"	Yes,	White,	105

The reciprocal (25/6) of the above generation showed an equally variable set of plants in all the respects above enumerated. One plant in this row (No. 4) was exceptional in having the fruits larger than any elsewhere and of a purple color, showing that it adhered more closely to the "American" type than any of its relations in the two rows. Plate XVI. shows some of the fruits gathered from the four rows in question, those at 1 being of the blend 6/25 and samples of its next generation are given to the right and representing six different plants, but no great range in

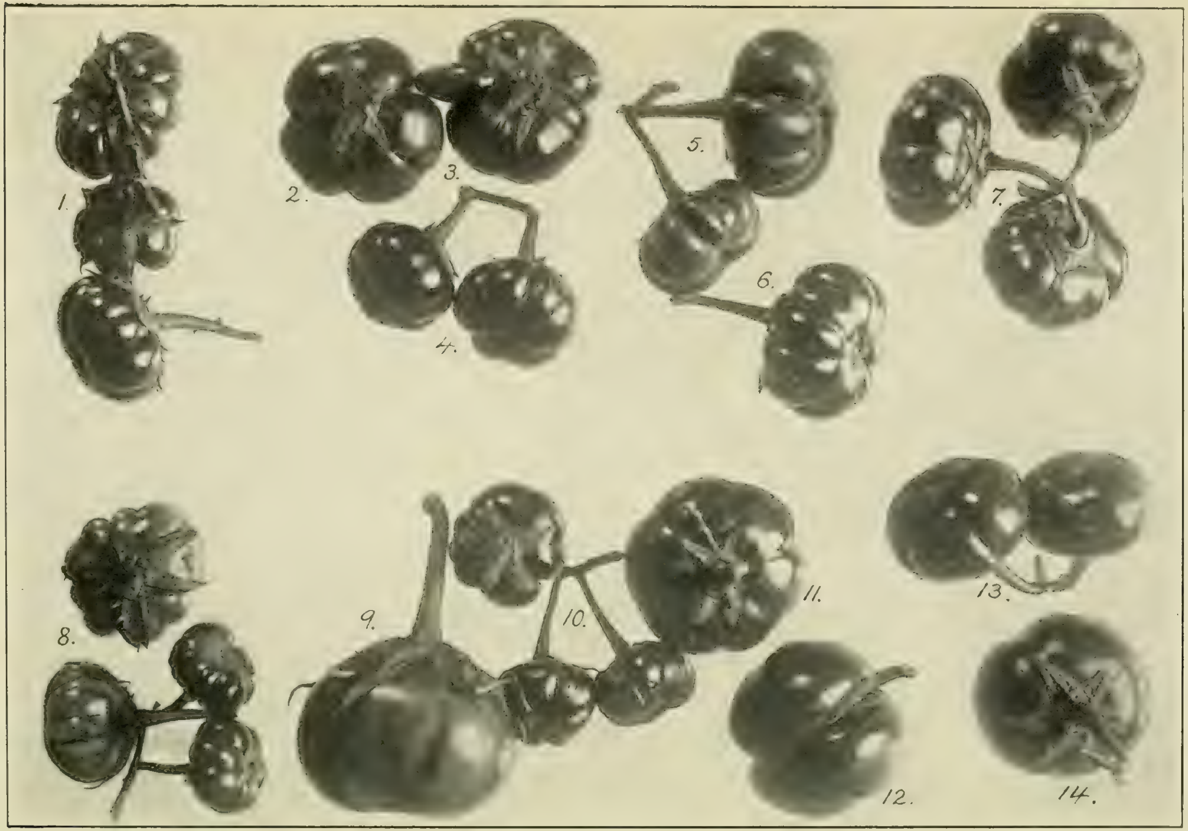

PLATE XVI. *"Dwarf Purple-Chinese" Hybrid Eggplants.* Samples of blend fruits are shown at 1, and of the reciprocals at 8; fruits of the next generation are given from 2 to 7 and their reciprocal below, 9 to 14, with an unusual type at 9.

size and shape. In the lower part of the plate at 8 are three sample fruits from the blend of 25/6, which are practically the same as those of the reciprocal shown above them. At 9 is the exceptional fruit previously noted that may be the starting point for a new variety of eggplant of commercial value. Further to the right are sample fruits from five plants and are quite like those of the reciprocal of the same hybrid generation shown above them.

In the table below is a statement of the facts for this set ot twelve plants closely comparable with that for the reciprocal row:

	Size.	Color.	Leaves.	Spines.	Flowers.	No. of Fruits.
No. 1,	Dwarf,	Purple,	"Oak,"	No,	White,	0
" 2,	Tall,	Purple,	Wrinkled,	Yes,	Purple,	4
" 3,	Tall,	Purple,	Wrinkled,	Yes,	Purple,	0
" 4,	Dwarf,	Purple,	Smooth,	Yes,	None,	21
" 5,	Tall,	Green,	Wrinkled,	Yes	None,	6
" 6,	Dwarf,	Purple,	Smooth,	Yes,	Purple,	20
" 7,	Dwarf,	Purple,	Smooth,	No,	Purple,	7
" 8,	Dwarf,	Green,	Smooth,	Few,	None,	17
" 9,	Tall,	Purple,	Wrinkled,	Yes,	White,	5
" 10,	Tall,	Purple,	Smooth,	Yes,	Purple,	27
" 11,	Tall,	Purple,	Wrinkled,	Yes,	Purple,	111
" 12,	Dwarf,	Purple,	Smooth,	Yes,	None,	34

A Study of the Blossoms of Hybrid Eggplants.

The flowers of the hybrids between the "American" and "Chinese" eggplants, when brought together, make a set showing a wide range in size and color. In the American sorts, all members of the species *Solanum Melongena* have large blossoms, usually of a strong purple, but subject to considerable variation in this color as also in the size; the white sorts with no purple in the stems and leaves have the flowers, as a rule, of a pale color, as if the once purple blooms had become much faded. The Chinese species (*Solanum integrifolium*) has white flowers that are comparatively small and, therefore, any union between the two above-named species might be expected to give some differences in the blooms.

The chief hybrids are between the "Dwarf Purple" (6), "Fordhook Improved" (14) and "Pride of Sunnyside" (20). Flower clusters with an open blossom from a large number of plants of these hybrids are brought together in Plate XVII. In the upper left hand corner are a few blooms from a representative of the "American" species and, scattered among them, a few of the "Chinese" kind, the latter being easily distinguished by their smaller size, apparent whiteness of the corolla and, last but not least, the stout "spines" that are upon the stems. To the right of the parents are thirteen clusters from as many plants of the hybrid "Dwarf Purple" upon "Chinese," one generation after the blend. It is seen that from 2 to 13 there are two blossoms (4 and 10) that are larger and evidently darker colored than the others; Nos. 2 and 8 are quite small and nearly white, particularly the latter. From 14 to 19 are the reciprocals of the same hybrid in the same generation, in which the variations are practically the same as for the first group. The set from 20 to 35 is of "Fordhook" upon "Chinese" in the second generation from the blend, that is, one year further on than the set previously considered. Here, certain blossoms are conspicuous for their large size and purple color as, for example, Nos. 21, 30, 31 and 35, while others, as Nos. 20, 22, 23, 24, 26 and 29, are small and generally white. There are some that are intermediate, but the individual differences are not easily determined from a picture; if 26 is compared closely with 34 the great contrast in size and number of particular parts is apparent. The four numbers from 36 to 39 are of the blend of "Pride of Sunnyside" upon the "Chinese" and the uniformity of the blossoms is fairly well shown.

The whole lower third of the picture, including Nos. 40 to 62, are of the hybrid in which the "American" blood is cut down to a quarter by breeding the first hybrid to the "Chinese" again. The blossoms average smaller than elsewhere, and there are but a few that show the purple color and the larger size suggesting the "American;" Nos. 48 and 54 are, perhaps, the largest of these, and their corollas are thin and pale as well as small as compared with the purple parent given in 1.

There is no great satisfaction in showing the flowers as a means of illustrating the individual differences in plants of a hy-

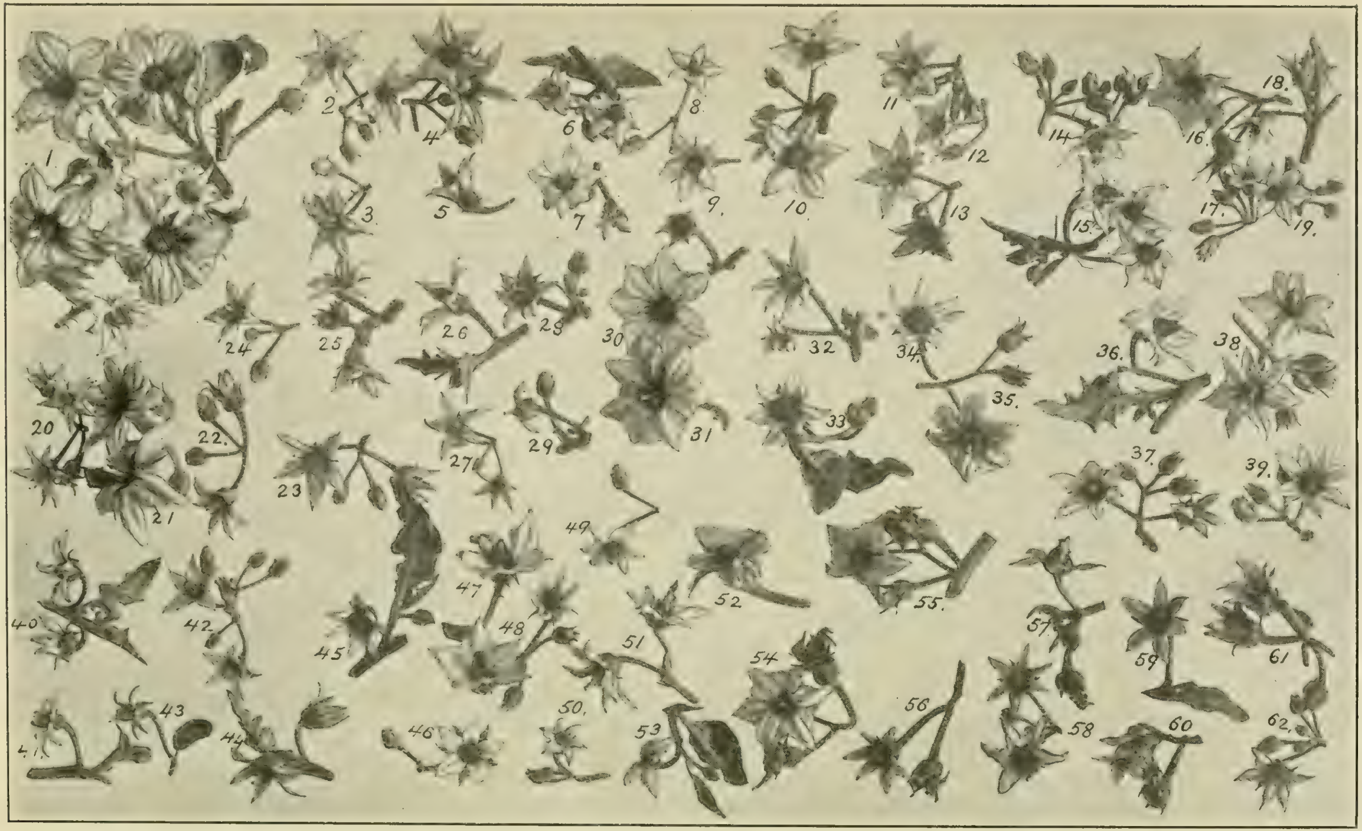
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Plate XVII. *Hybrid Eggplant Blossoms.* A set of sixty-two flower clusters from as many plants showing great variations, as compared with the two parents seen at **1.**

brid like this, for the whole plant varies from habit of growth to the notches in the leaves, some are dwarf, others tall, some smooth, others spinose, some green, others purple, some fruitful, others entirely barren, all of which differences enforce the rule that hybrids may give rise to many types and some of them are not easily accounted for from a study of their immediate parents only.

The Spinoseness of Eggplants.

One of the objectionable features—perhaps the chief—in handling eggplants is the stiff prickles that are usually present upon the base of the calyx and the stem of the fruit. This troublesome spinoseness has stimulated seedsmen to place the term "spineless' or "smooth" in the trade names of their eggplants long before the facts in the case would fully warrant it. The person who has been familiar with the crop in question in a practical way can speak feelingly upon this point and may agree that any efforts to eliminate the prickers are along a desirable line.

The "spines" in question are evident before the flower-bud is open and this renders it easy to decide early in the life of the plant as to its freedom from prickles; in fact an earnest of the spinoseness may be gained from the stems and foliage of the young plant before it has begun to form any organs for reproduction. The prickers are in particular upon the lower side of the main veins of the leaf, and may be quickly detected by drawing the back of the hand along under the leaves while they are still small. In the worst cases of spinoseness the objectionable sharp outgrowth is upon the stems in nearly all their parts.

A good opportunity of displaying the relative amount of spinoseness is offered by the young fruits taken soon after the corolla falls. Such a set is shown in Plate XVIII., in the order of the numbers in the engraving, upon which the following very brief notes are made:

1. "Black Snake" (2). Practically spineless.
2. "Black Pekin" (3). Practically spineless.
3. "New York Spineless" (9). Far from smooth.
4. "Early Dwarf Purple" (5). Spineless.
5. "Florida High Bush" (8). Very spiny.

6. "Long Purple" (12). Nearly smooth.
7. "Long White" (11). Has some stout prickles.
8. "Mammoth White Pearl" (15). Shows spines upon the stem.
9. "Round White" (26). Smooth.
10. "Striped" (21). Large spines.
11. "Station No. 1." Smooth.
12. "Station No. 2." Smooth.
13. "Jersey Belle" (10). Some spines.
14. "Jersey Pink." Some spines.
15. "Ivory." Some spines.
16. "Scarlet Chinese" (25). Spiny.
17. "Black Snake/Dwarf Purple" (2/5). Smooth.
18. "Black Snake/Dwarf Purple" I (2/5 I). Nearly smooth.
19. "Black Snake/Early Dwarf Oval" I (2/6 I). Spiny.
20. "Black Snake/New York Improved" (2/18). Spiny.
21. "Fordhook/Scarlet Chinese//Long White/Dwarf Purple" (14/25//11/5). Spiny.
22. "Black Pekin/Black Snake" (3/2). Smooth.
23. "Black Pekin/Dwarf Purple" (3/5). Some spines.
24. "Dwarf Purple/Black Snake" (5/2). Smooth.
25. "Early Dwarf Oval/New York Improved" (6/19). Spiny.
26. "Early Dwarf Oval/Scarlet Chinese" (6/25). Spiny.
27. "Early Dwarf Oval/Scarlet Chinese" I (6/25 I). Nearly smooth.
28. "Scarlet Chinese/Early Dwarf Oval" I (25/6 I). Spiny.
29. "Scarlet Chinese/Early Dwarf Oval" (25/6). Very spiny.
30. "Jersey Belle/Black Snake" (10/2). Very spiny.
31. "Jersey Belle/Early Dwarf Oval" (10/6). Some spines.
32. "Jersey Belle/New Excelsior Tree" (10/17). Nearly smooth.
33. "Long White/Black Beauty" (11/4). Some spines.
34. "Fordhook Improved/Scarlet Chinese" II, Plant 29 (14/25 II, Plant 29). Some spines.
35. "Fordhook Improved/Scarlet Chinese" II, Plant 33 (14/25 II, Plant 33). Some spines.
36. "Pride of Sunnyside/Black Beauty" (20/4). Some spines.
37. "Pride of Sunnyside/Scarlet Chinese" I (20/25 I). Very spiny.
38. "Scarlet Chinese//Fordhook/Scarlet Chinese" Plant 1 (25//14/25, Plant 1). Spiny.
39. "Scarlet Chinese//Fordhook/Scarlet Chinese," Plant 5 (25//14/25, Plant 5). Spiny.
40. "Scarlet Chinese//Fordhook/Scarlet Chinese" Blend (25//14/25, Blend). Spiny.

Notes Upon the Calyx Character in Eggplants.

As noted in previous reports, the calyx of eggplant fruits is far from constant in the character of color and also of the surface of the fruit beneath the calyx.

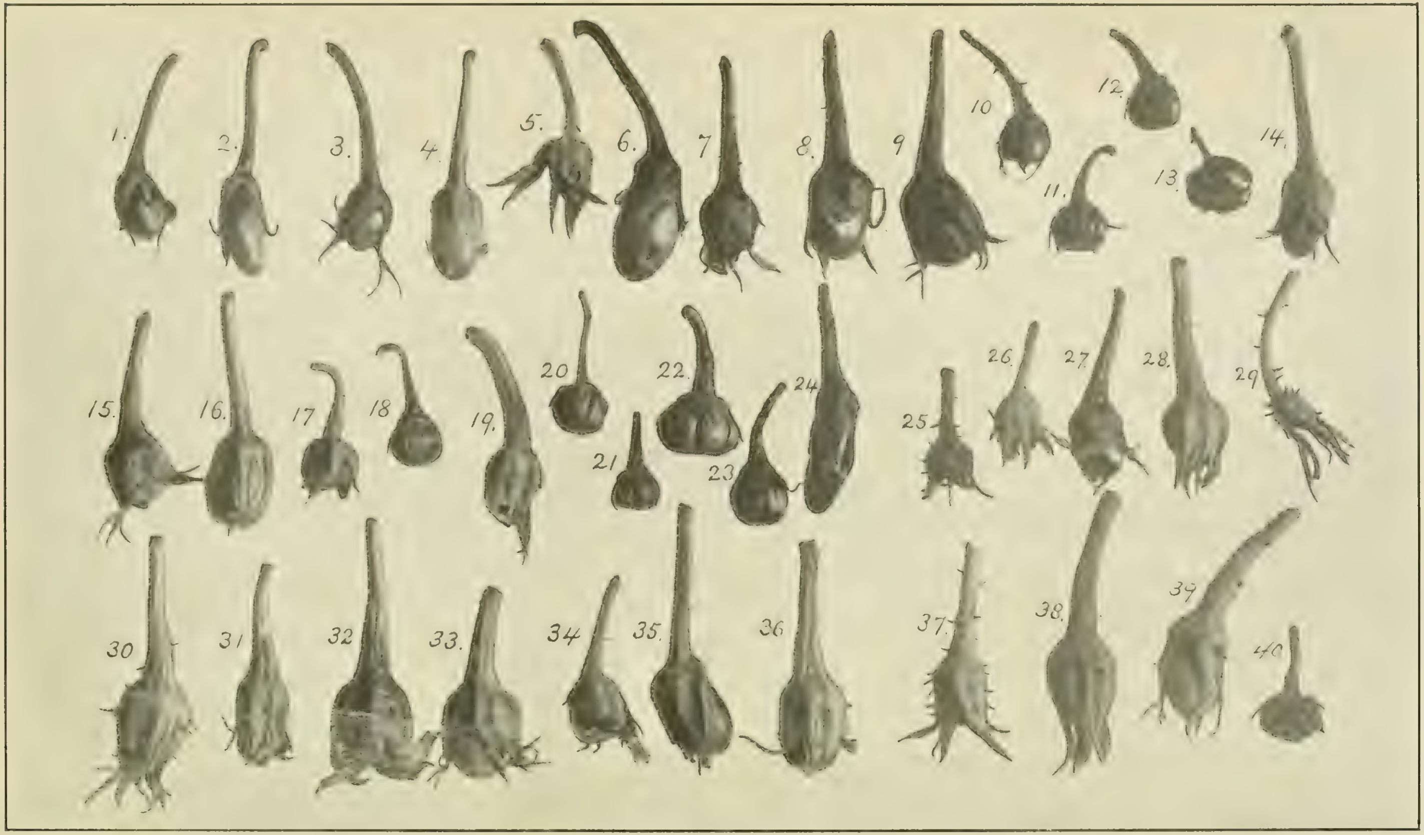
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PLATE XVIII. *Calyx Character Among Eggplants.* Young fruits from forty plants were photographed, showing the calyx in particular, and its spinoseness.

The "Black Snake," "Black Pekin" and "Dwarf Purple" all have the purple color of the exposed portions of the fruit absent from the protected part beneath the calyx. In the "Black Snake" the exposed surface of the fruit is a fresh light green, while that of the "Dwarf Purple" is nearly white (or a very pale green), and the "Pekin" has a shade of blue somewhat between the two, but more like the "Black Snake" than the "Dwarf Purple."

The "Jersey Belle" has a large calyx with several unequal lobes that extend down from the green stem and enclose the fruit until it is two inches in length. It is also thick, somewhat ribbed, with a few "spines" near the base, and has the prevailing color green with some showing of purple upon both the outside and the inside, the latter appearing as broad, irregular veins as the lobes are lifted for inspection. Upon the other hand, the "Dwarf Purple" has a small thin calyx that extends from the purple stem only a short way upon the fruit, often in only two lobes, and is of a deep purple upon the outside, pale purple beneath and not showing distinct veins. Prickles or "spines" are rarely met with upon the calyx, and those upon the fruit stalk are small and inoffensive.

The cross between the two above-mentioned sorts is more like the "Dwarf Purple" in its calyx than the other parent, being purple throughout the whole exterior, including the fruit stalk. The color is not so deep as in the "Dwarf" parent, and there are strong indications of the "blood" of the "Jersey Belle" in the ribs and the prickles—the grooves in the stem in particular showing streaks of green; the under surface of the calyx is purplish green. In size the calyx is medium between the two parents and, therefore, extends over the fruit much further than in the "Dwarf Purple." The point of particular interest is the color of the surface of the fruit beneath the calyx, which is a pale purple or dark pink and shows belts of deeper color at the lower margin where, by growth, the fruit has extended beyond the calyx.

In the "Dwarf Purple," when the calyx is removed the area it covered is seen with distinctness; the purple meets the pale green sharply. In the young fruits this line is less pronounced, because the growing fruit causes a series of fine bars or "waves" suggesting the shore line of the sea when near a calm.

The "Jersey Belle" shows, even in the young fruit, the purple color beneath the calyx, and when the latter is lifted there is no indication in color as to the portion that was unexposed. When the base of the fruit is reached the purple color ceases and the border is white and, meeting the purple in an irregular line, somewhat blends in a pale purple belt.

The cross shows an interesting blending of the two parents. When the calyx is lifted there are seen broad wave lines of purple near the base of the area covered, due (as before explained) to the extending of the fruit in growth beneath the calyx; and extending from the complex border is a light purple that fades into a very pale green as the base of the calyx is reached. In other words, the pure dark purple of the one parent and the pale green of the other is replaced by a fair average of the two, namely, the pale purple above mentioned.

In general terms, the above statement obtains with the cross of the "Jersey Belle" upon the "Black Snake" with this difference, that, as above mentioned, the "Black Snake" has much more green under the calyx than the "Dwarf Purple," and the cross shows a corresponding increase in the green. As the "Black Snake" is inclined to be streaked, so the cross shows this feature even under the calyx. It is noted in passing that, as the "Black Snake" is a "spineless" sort, the cross has some individual plants without prickles upon the calyx.

In the purple fruits of the "Long White-Black Snake" cross the calyx is large, long-pointed, with lobes that incline to be retuse and a mixed purple and green, as is also the fruit stalk. Under the calyx border are the usual bands of unequal purple, while the main portion of the area is green, corresponding closely to that of the "Black Snake." So far as color is concerned, the cross is the same as the color-bearing parent—the white seeming to have no influence upon the amount of purple present.

EXPERIMENTS WITH LIMA BEANS.

The experiments with Lima beans have been chiefly the continuation of the crosses that have been obtained in the "breeder rows" between the "Jackson Wonder" and several white-seeded sorts.

The "Jackson Wonder" Crosses.

Selections of five color seed-types were made from the 265 plants representing the several "Jackson Wonder" crosses grown in 1906. The number of parent plant in each of the crosses under the several types is shown at the left hand in the following table:

Parent Type.	"Jackson Wonder" Type.	D. Red.	L. Red.	Mott. Red.	White.
"Jackson Wonder" Type,	132	12	14	11	28
Dark Red "	14	48	29	1	19
Light Red "	2	19	62	6	30
Mottled Red "	12	1	13	19	15
White "	20	14	5	7	185
	180	94	123	44	277

As might be expected, the "Jackson Wonder" and "white" (that is, parental) types show the least variation, two-thirds of the "Jackson Wonder" and six-sevenths of the white progeny breeding true. From the dark red parentage, one-half of the resulting plants gave seeds with either dark or light red, while one-half reverted to the parents. Results from the light red give three times as many whites as "Jackson Wonder," but, placing the mottled reds with the "Jackson Wonder," the solid colors, 81 in number, are found to be a little over twice those conforming to the parent types. The mottled red gives practically the same numerical results as the "Jackson Wonder" type.

The plants of the "Jackson Wonder-Burpee" combination were a uniform set, of good bearing quality and with more spreading habit than the "Jackson Wonder" with the earliness of the latter parent. The "blend" of this cross, with a large, dark-red seed, was continued this year with the hope of securing a good white-seeded plant and gave twelve plants with the following results in seed color: "Jackson Wonder" type, 2; dark red, 4; light red, 3; white, 3.

The plants of the "Jackson Wonder-Henderson" cross were an even lot as both plants are similar in general plant characters. The prolificness of the "Jackson Wonder" is apparent in the white-seeded strain with beans somewhat larger than those of the "Henderson."

In the "Jackson Wonder-Willow-leaf" combination, three types of foliage are distinguished, the true Sieva of the "Jackson Wonder," the "Willow Leaf" and an intermediate. The object sought here is a more productive "Willow-leaf" plant, the narrow foliage and, therefore, open plant being a possible advantage. Nineteen "Willow-leaf" plants with white seed, varying in productiveness from the "Henderson" to the "Jackson Wonder," were obtained.

The "Jackson Wonder-Wood's Prolific" was grown in two separate lots, the "Runner set" being given the use of poles to encourage the tendency so strongly manifest last season. Of the 121 plants grown from this set, 84 had the true pole and 37 the bush form. The true bush plants of this cross gave progeny which, though of spreading habit, showed little running tendency. Their bearing quality was good, the pods being flat and of medium size.

The "Jackson Wonder-Station Bush," represented by the largest number of plants (forty-two), gave a fine even lot of offspring, early to medium-early, with medium-sized pods, while the bearing quality was excellent. Many of the seeds resembled the "Dreer" in plumpness.

Plate XIX. shows in the upper row a set of five types of color markings of "Jackson Wonder-Willow-leaf" seeds as found in a set of twenty-four plants, all grown from the dark red seeds of a single plant in 1906. The grandparent was a blend seed, the first generation from it split up into various color types and, from the progeny of a dark red set, the present one is selected as a representative of the second generation from the blend. The

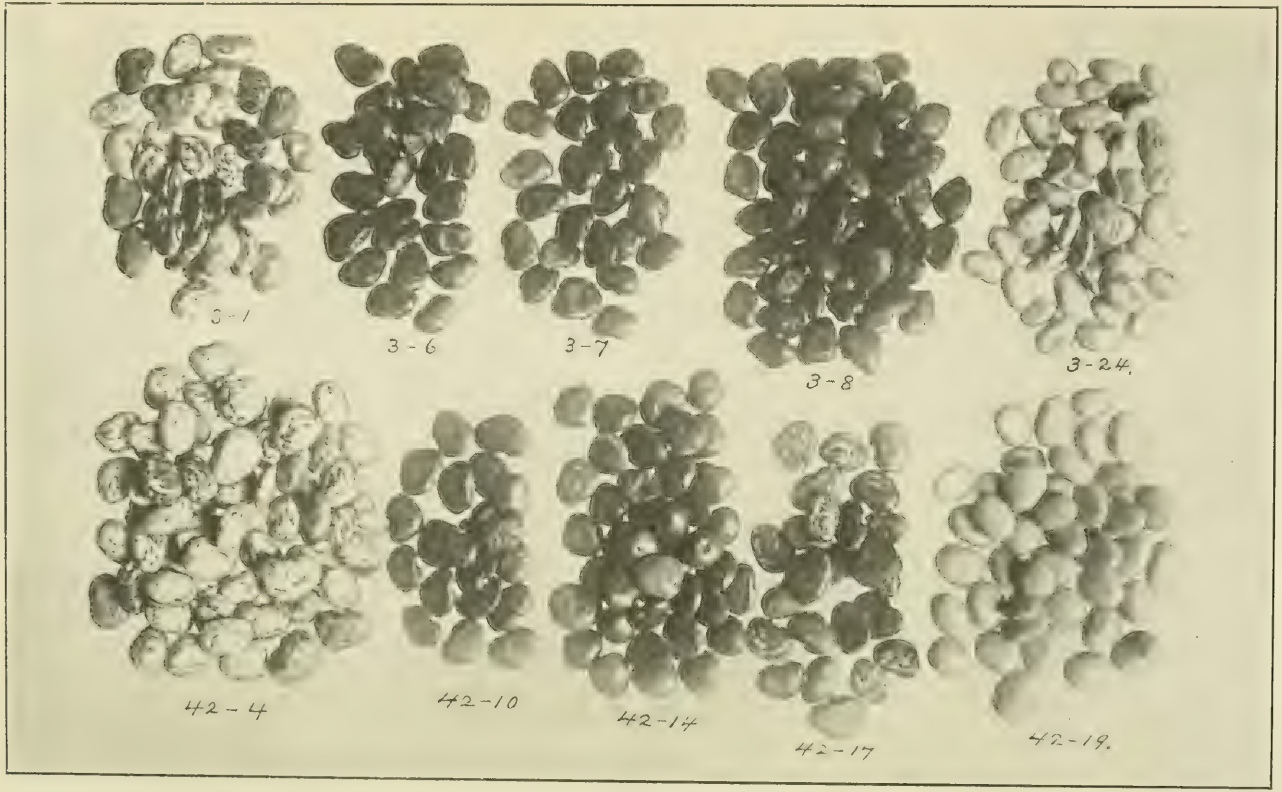
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PLATE XIX. *"Jackson Wonder" Crosses.* The upper row is of crosses with the "Willow-leaf" in its five leading types of seed markings, a corresponding set with "Station" being given in the lower row.

formula is: 91/97 B–3–1,* B–3–6, B–3–7, B–3–8 and B–3–24, looking from left to right. The first, "Jackson Wonder," and the fifth, "Willow-leaf," are the parent types; the second is a dark red like its own immediate parent, the third is similar to the second in being solid color but a light red, while the fourth is mottled dark upon a brick red background.

The "Jackson Wonder" itself is a variable sort, the seeds sometimes being quite dark and, at other times, the basal color is dark and the darker blotches are therefore indistinct. The brick red of number four, while blotched like the "Jackson Wonder," is so different in the color of its background as to permit its being separated from the parent type. The shade of red here varied greatly so that the sample shown is one that stands for many small varieties.

In the lower row is shown the seeds of five plants in the second generation of a cross of "Jackson Wonder" upon "Station," and in this cross the immediate mother of them all produced uniformly light red seeds. The formula for this is: 91/217 B–42–4, B–42–10, B–42–14, B–42–17 and B–42–19; that is, the sixth in the Plate is from plant No. 4, which is from plant No. 42, which is from the blend. The color types are very close to those shown in the upper row. The darker reds, 3–6 and 42–10, are quite similar, as also the other solid color set, 3–7 and 42–14, but in 42–17 the background is lighter than in 3–8 and suggests, therefore, a still closer affinity with the "Jackson Wonder."

If a set for the Plate had been selected from all the crop indiscriminately, a larger number of color types could have been shown, but those given are the chief ones quite constantly met with in all the crosses of the "Jackson Wonder" with the various kinds of white Lima beans.

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* To simplify record-making, the following scheme is used: The first generation is called the Blend, in which the characters of the two parents are often quite evenly united, and from the blend seeds the first generation after the blend is produced. The letter B stands for the Blend, and, following it with a dash between, is the number of the plant involved in the line of descent. The second generation, in the same manner, is indicated by the plant number concerned in the strain, and so on so long as the work continues, generation after generation. The following formula, B–3–21–14–7, shows that the work is expressed for four generations from the blend, and that the description, etc., that follows it concerns the 7th plant—in a list of any number, whose immediate ancestor is the 14th plant of the set making up the third generation, which in turn is descended from the 21st plant of the second, and the 3d in the first generation after the blend.

"Jackson Wonder-Dreer" Cross.

The blend of this cross made its appearance last year, and is one generation behind the crosses given above; it was of strong spreading growth with the large, light-green leaves of the "Dreer" type, a prolific bearer of good-sized pods, thicker than those of the "Jackson Wonder" and containing dark-red seeds of medium size. The twenty offspring from this plant, grown the present season, were of low, spreading habit, about half showing the "Dreer" foliage.

The plants in general were prolific and medium early, two were of the "Jackson Wonder" type in seed color, fourteen dark red, one light red and one greenish white. The last-named was a seed much smaller than either parent, with the "Dreer" plumpness, promising the superior table quality and color of one parent combined with the prolificness of the other. One pronounced "Dwarf" was especially small, scarcely more than three inches high, of compact growth with leaves of the "Dreer" type and bore but one short, thick pod.

Selection Experiment with "Kelsey" and "Station" Lima Beans.

In 1906, a small plot was devoted to a crop of "Kelsey" Lima beans using selected seed. From this lot of plants, the best individuals were selected and from them, the best seeds were planted the present season. The seed of the best plants has been saved separately for a continuation of the selection experiment.

With the "Station," one lot of seed was selected for their "flatness" and another because of unusual "plumpness." Last year, the "plump" strain showed a great tendency to run, and this has so much increased the present season that this strain has been discarded as practically worthless.

Selection Experiment with "Jackson Wonder" Lima Beans.

The "Jackson Wonder" variety exhibits much variation in the amount of color in the seeds and a selection experiment has been running for four years to fix a light and a dark strain. Thus, each season a set of seeds showing the least amount of red or purple blotching was planted under isolation and, likewise, a comparable plot with seeds of the oppoite extreme, that is, those having the greatest amount of the color. Last year, the conclusion was that the "selection has removed much of the white in the series of dark seeds, while the opposite is not so evident, namely, the seeds after three years of selection for whiteness are nearly as much colored as the regular stock of the variety." From the results of the present season there appears to be no decrease in the amount of color in the light lot while, contrariwise, the crop grown from the selected dark seeds averages much darker than last year. This lot, however, contains a great variety of seeds ranging all the way from white (in one plant) to those of a solid dark purple. A comparison of seeds of different years, furthermore, shows that the color of "Jackson Wonder" beans changes materially with age, the gray white of the blotched typical seeds becoming light brown.

General Observations Upon Lima Beans.

That natural crossing among the Limas is easily accomplished through the aid of insects seems apparent from the results gained in the "Jackson Wonder" experiments, where one variety, being dark-seeded, readily marks itself upon a white-seeded sort and the blend is readily distinguished by its usually solid dark red seeds or by those that are slightly mottled.

That the running tendency lies dormant in the bush varieties seems apparent in the resulting crosses; thus, the "Jackson Wonder-Dreer" blend has shown a strong tendency in that direction, and it was this character which led to the selection of "Jackson Wonder-Wood's Prolific" "Runner set." Seed from certain plants of the "Station Bush," that inclined to twine, was selected in 1905 and has developed into a true pole variety.

The "Willow-leaf" foliage in the Limas is a variable one, and gradations from the very narrow form of the true "Willow-leaf" to the broad "Willow" approaching the Sieva foliage may be met with in any block of crosses of this variety.

EXPERIMENTS WITH BUSH BEANS.

Bush, or "snap," beans occupied a large part of the strips, where they were planted in blocks that separated the several plots of sweet corn. The following are the crosses that show most of promise and from which seeds, selected from the choicest plants, have been saved for further testing upon the Home Grounds and, in some instances, elsewhere by those who may desire to grow them.

"Everbearing Cylinder" (17/110).—The "Everbearing" is a variety with long, flat, green pods, bearing flat white seeds; and the "Cylinder" has a long, round, stringless wax pod, with black seeds. The white seeds of the cross were used for the present crop and no plant showed any color in its seed or blossom. From the mother came the compact bushy type of plant and the stringless wax pod and, from the male parent, the desirable white seed. The round pod of the "Cylinder" failed to appear upon any of the seventy plants.

"Longfellow-Marrowfat" (26/29). This gave an even lot of plants with long, straight, round pods of the male parent. The pods, although brittle and tender, are not stringless when ready for market.

"Longfellow-Davis" (26/112). Plants from the selected white seeds had the upright habit of "112," and bore plentifully of long, straight, flat wax pods, which, while resembling the "Davis," were less stringy.

"Davis-Keeney's Refuge" (112/133). Here again, selection for planting was made of the white seeds, and a desirable type of plant and pod was secured.

"Detroit-Black Wax" (113/117). From this cross has been selected the round-podded type, and it has proved to be of super-

ior quality, being an early, prolific bush, with medium-sized, round, brittle, stringless wax pods. The set of plants was remarkable for its uniformity in all respects.

"Golden Scimitar-Davis" (129/111). The white-seeded plants of this cross were used for continuation of the breeding, and a choice lot of medium late plants was grown, bearing an abundance of long, curved, round pods.

"Jones' Stringless-Golden Eye Wax" (131/130). This cross, continued from selected white seed, was represented by a large number of plants and proved to be an even lot of early, prolific plants with medium-sized, flatish wax pods. No strictly round pod has appeared, but the superior quality of the "Jones" parent is shown in the brittleness of the pod, which has little or no string at the marketable stage. It is the intention to offer this freely for testing by the truckers.

"Crystal-Brittle Wax" (145/101). Of the several types, in pod and seed, which have resulted from this combination, the round, white wax seems the most promising, being prolific and very brittle, although not entirely stringless. The white-seeded "Crystal Wax" pods (larger than the parent) which have appeared thus far have, with few exceptions, been tough and stringy, lacking the brittleness common to both parents. Selection of individual plants with the "Crystal" pod and least stringiness has been made with the hope of securing the desired results. Certain plants have given long, round, white-seeded green pods, from which selection has also been made.

"Crystal-Davis' Wax" (145/112). The selected white seed has bred true, giving low-spreading plants, medium late in season, with an abundance of medium-sized, round, straight or curved white wax pods, very brittle and practically stringless. This promises a variety of excellent quality for the later market.

More Recent Bean Crosses.

Of the eighty-two crosses grown on the Strips this season, twenty-nine resulted from last year's pollination, and, while promising some desirable new combinations, with one or two exceptions have not been carried far enough to warrant a detailed description.

"Black Valentine-Crystal Wax" (45/145). The reciprocal of this cross was pictured in the last annual, giving a desirable round-podded "Black Wax," but with the above combination results have been different. No wax pod has appeared, although the "Crystal Wax" types of pod and seed are in evidence, but in the case of 145/45 neither the type of pod nor of seed belonging to the male parent have occurred in any generation of the cross, in all, representing several hundred plants.

"Crystal Wax-Market Wax" (145/135). This cross is mainly interesting because of its seed variations. The blend plants were spreading, with strong running tendency, bearing plentifully of medium-sized, flat green pods with a dark mottled seed, appearing black when dry. In the breaking up of the blend, "Crystal Wax" pods and white seeds appeared, but the pod quality was inferior, due largely, no doubt, to the fact that both parents are stringy. From the combination of the white and yellowish brown seeds of the parents, the following types have resulted: Black, mottled, two shades of brown, and white.

Of the remaining twenty-seven crosses, the following promise most from the standpoint of good parentage:

"Brittle Wax-Pencil Pod Wax" (101/148).

"Davis-Lima Wax" (112/175).

"Crystal Wax-Canadian Wonder" (145/8). Here a new type is sought for in the shape of an upright, bushy plant, bearing large, broad "Crystal" (silvery grey) white-seeded pods.

"Pencil Pod-Burpee White Wax" (148/149). This cross may unite the fine, round, stringless pod of the former with the earlier season, and white seed of the latter.

Promising "Dry Shell" Crosses.

Certain combinations under the "Less Desirable" group last year, as "Lightning-Marrowfat" (25/28), were spoken of as promising a "dry shell" bean. By that is meant a variety which has no special pod merit, but produces a seed (usually white) which is desirable for cooking when dry. Commercial varieties of recognized merit for this purpose are the "Prolific Tree," "Burlingame Medium," "Yellow Eye," "White Marrowfat," "White Kidney," and "Red Kidney."

"Lightning-Marrowfat" (25/28). Neither parent produces a good snap bean, pods of both being flat, tough and stringy. The one merit of the "Lightning" is its extreme earliness, and this quality, combined with the more prolific white-seeded "Marrowfat," has produced a medium, prolific bush plant, free from the running tendency of the mother. The flat green pods are of medium size, containing seeds smaller than the "Marrowfat."

"Lightning-Prolific Tree" (25/34). The "Prolific Tree," as its name indicates, bears an abundance of rather small, flat pods upon a late plant. The white seeds are a "Pea" bean and of fine cooking quality. The resulting cross gives evidence of more earliness.

"Lightning-Davis' Wax" (25/111). This cross has resulted in large plants with flat green pods containing white seed of the "Davis" type, which resemble the commercial "White Kidney," though smaller. It promises a desirable new Kidney bean.

"White Marrowfat-Canadian Wonder" (29/8). The mother plant is distinguished by its large, thrifty, bushy plant with very long, flat, green pods. The seeds of the cross resemble those of the "Red Kidney," but are of a darker red and larger, with the rich quality of that variety. Either the "White Kidney" or the "White Marrowfat" type of seed, combined with the richness of the "Canadian Wonder," is desired in this cross.

"Green Winter-White Marrowfat" (51/28). Here it is desired to combine the earliness of the "Green Winter" with the large, round seed of the "White Marrowfat." Another white "medium" variety seems possible through judicious selection.

"Burpee's Brittle-Wonder of France" (101/52). Both parents have medium-early, bush plants, while "Wonder of France" has a medium-sized white seed and is a good bearer. The expected round pod has failed to appear in this cross, but a white-seeded green pod has resulted with medium-sized beans, promising another good variety.

Novelties or Commercial Kinds Not Before Grown in the Gardens.

The following varieties have been added to our list for 1907 and assigned record numbers as seen below:

No. 200. *"Black Eye Wax"* (Leonard). An early, medium-sized bush, pods medium length, flat, curved. Seed resembles "Golden Wax."

No. 201. *"Celestial Wax"* (Tait). This is an early "Black Wax."

No. 202. *"Double Barreled Wax"* (Landreth). A medium long, round, curved, early wax pod, flowers pink, seeds resemble the "Yellow Six Weeks."

No. 203. *"Early Cholet"* (Hend.). A small bush plant, early in season, with long curved pods, seeds golden brown with darker eye.

No. 204. *"Golden Queen"* (Greg., Noll). Strong-growing plants with long, flat, curved wax pods; medium early, seeds a mottled red.

No. 205. *"Landreth's Wax"* (Landreth). Plants of good size, early, bearing flat, curved pods, seed mottled dark red.

No. 206. *"Long Pod Forcer"* (Thorburn). An early, long, flat, curved green pod with seeds of the "Six Weeks" type.

No. 207. *"Michigan White Wax"* (Ferry). An early, medium length, rounding, curved, wax pod, with white flowers and seed.

No. 208. *"New Pearl"* (Bolgiano). Strong-growing plants, pods similar to those of "Golden Queen," mottled red seeds.

No. 209. *"Powell's Yellow Giant"* (Vick). This proves to be a Pole bean with large, flat wax pods and white seeds.

No. 210. *"Sunshine Wax"* (Bolgiano). Bush plants bearing medium-early, small, flat, curved wax pods, flowers and seeds white.

No. 211. *"Wingold Wax"* (Maule). Plant medium in size, bearing early, short, rounding, curved wax pods, seed has dark "eye."

No. 212. *"1907 Bean"* (Bolgiano). A medium-early, round green pod with mottled red seed.

No. 213. *"Mexican Bean"* (E. B. Voorhees). Spreading plants with dark green leaves, sending out runners, beginning to bloom (September 10th), with flowers white, pods of good size, flat, green, prevented from maturing by frost.

No. 214. *"Fordhook Bush,"* Lima. Plants are large, compact in growth, with an abundance of large, plump pods resembling "Dreer," but larger. The greenish white seed is large and plump, being shorter than that of the "Ideal Pole."

No. 215. *"Improved Bush"* Lima. This resembles the old "Henderson Bush."

No. 216. *"New Ideal Pole"* Lima. Strong growing, large-leaved plants, with large, broad, thick, curved pods; season medium early, large plump, kidney-shaped seeds, greenish white in color.

Government Beans.

U.S.D.A. 20002. The stand was poor and the late bearing plants had carmine-colored pods with mottled red seeds.

U.S.D.A. 20003. The plants were spreading with tendency to run, bearing long, flat, curved green pods, which were striped or tinged with red, and contained large "kidney" beans with longitudinal stripes.

U.S.D.A. 20004. The plants were open, spreading and inclined to "run," bearing long, curved, flat, medium-early green pods with white seeds.

U.S.D.A. 20396 This was an early bush variety with medium long, flat, curved green pods bearing mottled red seeds.

U.S.D.A. 20397. This was a late variety with flat, slightly curved green pods.

U.S.D.A. 20398. The plants were medium late, open and spreading with flat green pods of medium length containing pale yellow seeds.

U.S.D.A. 20399. These spreading plants bore flat, curved pods of medium length with white seeds.

U.S.D.A. 20900. These spreading plants had small leaves, following the "Mexican" type in habit of growth and late season. No blooms formed up to Sept. 9th.

U.S.D.A. 20901. This plant is similar to 20900 with a few white blooms.

U.S.D.A. 20902. This is another late spreading variety, not yet in bloom (Sept. 9th).

U.S.D.A. 20903. This variety resembles 20902 and not yet in bloom (Sept. 9th).

U.S.D.A. 20904. This is a good bearer, medium early in season, with a small crop of flat, curved pods bearing light grey seeds with a yellow "eye."

U.S.D.A. 20905. This variety conforms to 20904 in plant and pod types with black seed.

U.S.D.A. 20939. This plant is spreading in habit bearing a few flat, straight green pods.

U.S.D.A. 20940. The plant is spreading with white flowers and flat green pods forming Sept. 9th.

U.S.D.A. 20941. The plants are late with spreading habit and beginning to bear white flowers Sept. 9th.

U.S.D.A. 20942. These are upright bushy plants with large leaves, white flowers and straight, flat green pods.

EXPERIMENTS WITH HYBRID BEANS.

Hybrids between the "Scarlet Runner" upon bush beans were obtained in 1905 and seeds planted late the same year gave profuse blooming plants quite slow to produce seeds. The pods that did mature were much smaller than those of the male parent, *Phaseolus multiflorus,* and lacked the roughness characteristic of the pods of this ornamental climbing plant. The seeds (blend) obtained resembled the "Scarlet Runner" in being marked with red but were of much smaller size.

In 1906, thirteen plants were grown of the hybrid of the "Scarlet Runner" upon the "Tennessee," above mentioned, under the record fractional number of 63/43. The mother of the cross is a tall variety of bush bean with white flowers and long green pods that produce seeds of medium size and of a light brown color. The blend seeds for this crop were planted May 1st, and the results in seeds were shown in Plate XVII. of last year's report, accompanied with a description of each lot. There was great variation in many respects, certain plants being nearly barren while others were prolific; no two had seeds alike in size, shape and color.

Plantings were made the present season from each of the thirteen lots of seed, and, at harvest time, the following among other notes were made:

B–1. The parent seeds were "solid dark purple," from which the following results, in terms of seeds only, were obtained: 7 black-seeded plants, 6 mottled dark, and 1 mottled brown.

B–2. The parent seeds were "yellowish brown with fine indistinct mottling," from which the following result was obtained: 1 white-seeded plant.

B–3. The parent seeds were "yellowish brown." From which were obtained: 3 plants mottled dark, 1 mottled grey, 1 white, 1 mixed (white, mottled purple).

B–4. This plant was large with red flowers and the most prolific of the set of thirteen grown in 1906. The seeds were borne close in the pods and angled at their ends and had a "grey color with fine bluish mottlings, becoming darker near the 'eye,' " resembling neither parent. From this set 32 plants were grown, giving in terms of seed characters the following tabular results: 10 grey mottled like parent, but no two plants were alike in this respect; 10 solid light brown; 9 white; 2 mottled dark brown, and 1 mottled ochre brown. Representatives of the types in this set are given in the upper row of piles in Plate XX., arranged from left to right as follows: B–4–1, B–4–2, B–4–11, B–4–21, B–4–26.

B–5. The parent seeds were "slightly mottled, with grey background." The following results were obtained: 2 plants with mottled seed.

B–6. The parent seeds "resembled blend type." The following results were obtained: 5 plants all mottled dark.

B–7. Failed.

B–8. The parent seeds "were similar to blend (mottled purple)," and yielded the present season: 4 plants with mottled seeds.

B–9. The plant is recorded as being large, spreading with purple flowers, etc. "The seeds making the second largest group were of good size and shape and uniformly of a dark purple color, appearing almost black." Of the 32 plants grown 18 were like the parent, dark purple; 7 white; 3 mottled purple like the blend seeds but smaller; 1 indistinctly mottled upon a seal brown; 1 motled dark brown; 1 mottled light brown, and 1 mottled dark with a white back. Samples of these same types of seeds are shown in Plate XX. under B–9–1, B–9–4, B–9–5, B–9–6, B–9–10, B–9–25 and B–9–28, respectively, the size of each pile showing the total output of the plant.

B–10. The parent seeds were "seal brown with purple blotches," from which the following results were obtained: 3 mottled purple; 3 white; 2 dark brown.

B–11. Failed.

B–12. This was a medium-sized plant with red flowers and short, flat pods, which matured early seeds that were mottled with dark brown upon a seal brown background. From this set 21 plants were grown with seeds as follows: 8 seal brown mottled, resembling the parent, but variable; 4 dark brown (almost black); 3 mottled dark brown; 2 light grey with brown "eye"; 2 indistinctly mottled light grey; 1 mottled grey, and 1 a clear light blue. Representatives of all these types are given in the lower row of Plate XX., arranged from left to right as follows: B–12–2, B–12–9, B–12–13, B–12–14, B–12–18, B–12–21.

B–13. The parent seeds were "dark purple with white end" and the following plants were obtained: 2 plants dark purple (approaching black).

From the Plate it is seen that there is great variation in the number of seeds that each plant produced. The set from B–4 is the most uniform in large output and kept up the record made by the parent, while the offspring of B–9 are remarkably variable. In shape no two are alike in the set shown for B–4, the smallest being B–4–1 and the largest B–4–11, but the contents are not well shown in the picture because some, as B–4–21, are very plump and the next pile to the left, B–4–11, has quite flat seeds. The same sharp contrast in size and shape is brought out in

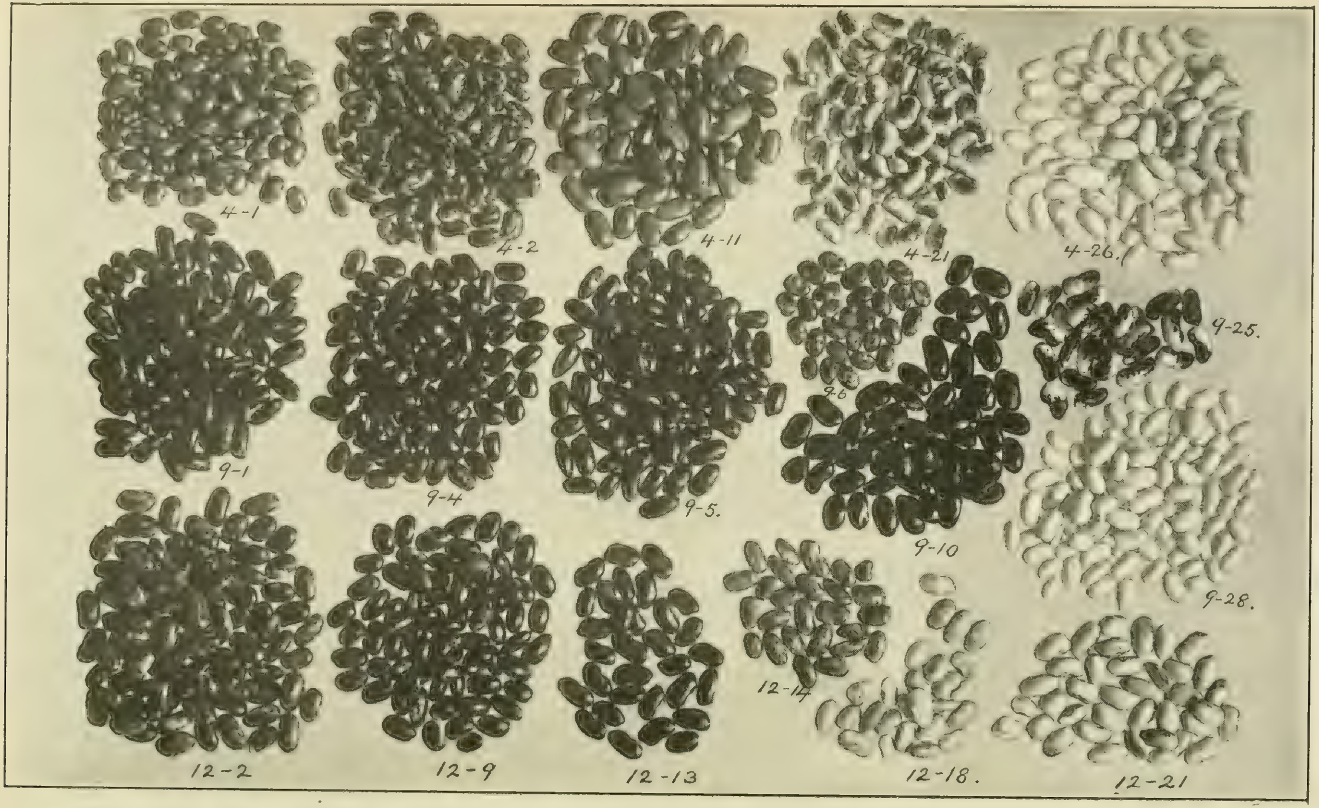
4-1
4-2
4-11
4-21
4-26.
9-1
9-4
9-5.
9-6
9-10
9-25.
9-28.
12-2
12-9
12-13
12-14
12-18.
12-21

PLATE XX. *Hybrid Beans: "Scarlet Runner" upon "Tennessee."* The upper row shows representative types of B-4-1, Series; the middle row of B-9-1, Series, and the lower row of B-12-1, Series,

B-9-6 and B-9-10, where the former are nearly round and the latter flat as Limas and adhere closely to the "Scarlet Runner" parent. In the lowest row, B-12, the color is the most unlike visible character, for it ranges from a solid dark brown (nearly black) and solid blue through mottled browns and greys to seeds that pass for a dirty white with a brown "eye."

It is seen from a study of the offspring from the ten sets of plants that there is a showing of white in B-2, B-3, B-4, B-9 and B-12, or a full half, and a total of 18 plants with solid white seeds and several that carried very little color of any sort.

It is not the purpose here to account for this absence of color in the seeds of hybrids, the parents of which were far from white, but it may be said in passing that any color possibly may hide the character that, otherwise, might produce a white seed. Thus, in sweet corns, it is established that black or yellow grains may carry "white" blood that, in the next generation, will show itself when both parent germs are free from the color character. The "Scarlet Runner" has a white-seeded strain, and the seed used for the hybrids in question may have contained more or less of this white character, obscured by the mottled purple of the normal seeds. In like manner the light brown seeds of the "Tennessee" may have carried the same "tendency" to produce white; one or both of which suppositions would be enough to account for the white-seeded plants met with. There may be another principle in breeding that is at work here.

"Scarlet Runner-China Red Eye" Hybrid (63/9).

The hybrid above mentioned is now in the first generation after the blend, and the seeds from the nineteen plants are represented by the formula B-1, B-2, etc. Ten of the plants were early in fruiting, one medium early, two medium late, four late and two unrecorded, fifteen being of the bush type and four running or wide-spreading. In color of blossom the range was from white, (the largest number) through pale stripes, pink to salmon and purple. The pods were quite variable, upon some plants being short and flat, others long and curved, with or without stripes. Among the seeds but little variety of form and marking prevailed. All were mottled and, therefore, showed no pure white seeds, and thirteen showed unmistakably the "Scarlet Runner" parentage in the flat, kidney-shaped seed and the dark purple blotches upon a lighter background of the same color. Three sets showed white upon the back, which may be due to the "China Red Eye," which has a white seed with a pink "eye." This latter character is not seen in any of the hybrids.

In this hybrid the type of plant follows closely the bush parent, but in the seeds there is a strong likeness to the "Scarlet Runner."

EXPERIMENTS WITH SQUASHES.

Summer Squashes.

Space does not permit of the full statement in tabular form of the results of the large area of summer squashes. From hand-worked fruits, either within the plant or the cross, of forty crosses grown in 1906, selections of seed were made this season of those that conformed to desired types with acceptable size and freedom from warts. Twenty-five rows of squashes were grown from seeds from close-fertilized fruits and twenty-three from those that had been pollinated within the cross.

The total number of fruits in the rows planted with close-fertilized seeds was 799 and in the rows with seeds fertilized within the cross, 804, giving an average of 32 fruits and 35 fruits per row respectively. The fruits in any row adhere more closely to parent type than last year.

From a study of the results, it is found that of the twenty-five sets of plants from close-fertilized seed but two showed any marked variation from the type of the parent fruit. Among the sets from seeds resulting from pollination within the cross but not within the plant, the conformity to type was somewhat less general. It is evident that the "Jug" type of squash is becoming fixed.

The "Strickler-Golden Bush" Squash Cross.

Among the fifty and more crosses grown upon the Home Grounds this season, no row excelled the above combination in the vigor and healthfulness of the vines and the number and large size as well as uniformity of the fruits. In 1905 the record shows that of this cross twenty-two plants were grown, all of them dark green and producing solid yellow (or orange) colored fruits with a broad neck, straight or nearly so, and showing but little wartiness. A study of the parents as to shape of fruit might lead one to project in advance the probable outcome of the union. The color of the two is so nearly the same that no change in this might be expected and the extreme flatness of the "Scallop" and the elongation of the "Strickler," which is not as "goose-necked" as the true "Crookneck," would suggest a form midway between them; and this is fully realized in the result. In length, the cross is not equal to the "Strickler," and along with the abbreviation there is the retention of the scallop features of the mother, but instead of this being a rim to the body of the otherwise oval fruit it assumes the nature of a series of long folds or corrugations that extend for some inches over the central portion of the fruit. It may well bear the name of "Fluted Orange."

Last year the report stated that the forty-two large, early, warty fruits of this cross were chiefly orange-colored and in type close to the parent, namely, an elongated "jug." The fruits this season have exceeded in length those of last year, and it remains to be seen whether they will hold to the type that is quite uniform in the row of eight hills now maturing.

The "Jersey Green" Summer Squash.

A strain from the cross of "Scallop" upon "Crookneck," after four years of selection, has become well fixed in shape and color, and seeds of it will be offered for distribution. The size and shape of the fruits are acceptable, being a long-neck "jug" of medium size, entirely without warts, and when ready for use are of a handsome, solid, dark green color.

The following table gives the percentage of flesh in fruits of the above-named commercial varieties and crosses of summer squashes:

	Large fruit.	*Medium.*	*Small fruit.*
"Crookneck,"	74%	....	81%
"Scallop,"	88%	....	87%
"Crookneck/Scallop,"	71%	....	70%
"Scallop/Strickler" (a),	81%	....	87%
four fruits,	80%	....	83%
"Scallop/Strickler" (b), three fruits,	83%	90%	86%
"Scallop/Strickler" (c), three fruits,	74%	78%	70%
"Fordhook" (a),	40%	....	50%
" (b),	77%	....	80%
"Cocozelle" (a),	78%	....	77%
" (b),	78%	....	73%
"Michigan" (a),	88%	....	66%
" (b),	88%	....	83%
Average,	77%	84%	76%

There is no marked difference between the percentage of flesh among the large and small fruits. The weights were not taken but the small were not far from a third of the weight of the large fruits. The following results were obtained of the number of seeds in large and small fruits upon the same plant:

	Large fruit.	*Medium.*	*Small fruit.*
"Crookneck,"	430	....	355
"Scallop,"	340	....	205 (immature)
"Strickler/G. Bush" (a),	325	....	255
" " " (b),	215	....	300
" " " (c),	245	....	280
" " " (d), three fruits,	280	230	375
"Crookneck//Scallop/Crookneck,"	360	....	265
"Crookneck/Scallop,"	165	....	280
"Scallop/Crookneck,"	550	....	515
"Crookneck//Scallop/Crookneck,"	285	....	365
"Scallop/Strickler" (a),	425	....	360
" " (b),	425	....	450
four fruits,	390	....	405
"Scallop/Crookneck" (a) three fruits	250	65	350
"Scallop/Crookneck" (b) three fruits	70	360	455
"Fordhook" (a),	200	....	120
" (b),	155	....	280
"Cocozille" (a),	285	....	130
" (b),	450	....	360
"Michigan" (a),	205	....	85
" (b),	180	....	350
Average,	297	218	311

The number of seeds is practically the same for the large and small fruits. In three instances, where three fruits from the same vine were seeded, the number of seeds increases from the oldest to the youngest as 166 : 252 : 460.

As to the relation between size of fruit and that of the seed, it was found that the large fruit gave larger seeds than the small fruit in every instance.

Summer Squashes New to the Home Grounds.

Three commercial varieties of summer squashes were grown upon the Home Grounds the present season, namely, "Fordhook" (51), "Cocozelle" (52) and "Michigan" (53). The first two had failed in attempts to raise them in previous years.

In the "Fordhook," one has a small, early bush variety that bears small cream-colored fruits, approaching in shape type No. 15, which is a ribbed "jug" without warts, and less elongated at the base. This variety has a fine, thick flesh and may prove a desirable parent in some of the crosses that have been secured with it.

The "Cocozelle" is a strong-growing sort with heavy vines, quite inclined to "run" and bear freely the very large elongated pear-shaped fruits that are nearly solid green when young, but take on ribs of orange at maturity. The flesh is not firm and the quality only fair, but there are qualities of plant and fruit that give hope for better things in the crosses to be expected with it next year.

The "Michigan" is a true vine squash that made it seem out of place among the bush sorts. The fruits are long and slender, like huge cucumbers, but with a peculiar lead color. In quality, it was variable, doubtless depending upon the age of the fruit when used for the table; gathered when two-thirds grown, it proved acceptable and, producing squashes throughout the whole season, this kind may be highly prized by many. It crossed readily with the regular bush varieties of its species, and possibly some new types of bush and vine summer squashes may result therefrom.

Winter Squashes.

The winter, and all vine, squashes were assigned to the Smock Land, where a large area was devoted to them and a long list of commercial sorts, not before grown by the Department, was added to that of the crosses previously secured. Soil and season conditions were not favorable for a satisfactory crop, and whatever is given below concerns plants and fruits that were not up to the average in vigor and size.

Relative Amount of Flesh in Squashes.

A study of the flesh content of vine squashes in particular has been begun as a factor in the advance toward better fruits. The method of determination consisted in plunging the squash (first washed of all adhering soil) into a tall vessel filled with water to the brim and catching the water of displacement in a dish into which the tall jar had been set. This water thus overflowing was weighed and later, in a similar manner, a corresponding record was made of the water displaced by the two halves of the squashes, held side by side, after the seeds and worthless shreds (plasentæ) has been removed. The weight of the water displaced by the two halves, divided by that of the whole squash, gives the percentage of the flesh; thus, should the displacement of the halves be 75 ounces, and 100 ounces be that of the whole squash, it is evident that the seed cavity makes up 25 and, therefore, the flesh is 75% of the whole fruit.

The value of a summer squash, that is, its amount of food, is not measured entirely by the flesh, for with these the whole fruit is cooked with the exception of the skin, which is often removed when the fruit is somewhat advanced in age. It is, however, true that the part of greatest value is the flesh, and a variety may be best that has the largest percentage of flesh and, therefore, as one method of improving this vegetable fruit means are being taken to increase the percentage of the wall of the fruit and, therefore, reduce its often large contents.

With the winter squashes the case is clear that a fruit with a thin flesh has far less food than another of the same size with a thick flesh. It is still to be shown that there is any correlation between the thickness of the flesh and its quality, but, from the standpoint of quality, the thin-fleshed squash is ruled out.

The following are the results that were obtained by the "hydrometric" method described:

STATISTICS OF WINTER SQUASHES.

KIND.	Relative size. L—large. S—small.	Weight of whole squash—lbs.	Weight of flesh in lbs.	% weight of flesh.	Thickness of flesh in inches.	Volume of flesh in percentage of whole.	Number of seeds.
"Warren" (7),	L	9⅝	9⅛	95	1¼	81	130
	S	6¼	5¾	92	1	80	330
Hub/B. Marrow //,	L	7½	7⅛	95	1 1/16	81	425
Delicious/G. Hubbard (1/2//3/4),	S	5⅛	4⅜	85	1 5/16	90	330
	L	8½	8	94	1⅛	79	245
	S	6	5½	92	1	79	225
"Delicious/Hubbard" (3/1),	L	6⅜	5⅞	92	1	72	300
	S	3¾	3¼	87	¾	73	270
	L	7½	6¾	90	1¼	73	320
	S	3¾	3⅜	90	1	73	275
	L	6½	5⅞	90	1⅛	74	475
	S	5½	5	91	1⅛	78	560
	L	5½	5	91	⅞	71	390
	S	3⅝	3⅛	86	1	71	485
	L (I)	2⅝	2⅜	90	⅞	73	200
	S (II)	2¼	1 15/16	86	¾	75	170
"Delicious/G. Hubbard" (3/4),	L	6	5¾	96	1	76	220
	S	3⅛	2¾	88	¾	76	220
	L	4½	3⅞	91	1	80	165
	S	2⅝	2⅛	81	⅞	77	240
	L	6¼	5¾	92	1¼	76	330
	S	3¾	3⅜	90	1	74	60
	L	5¼	4½	86	1	70	430
	S	2⅞	2½	87	⅞	81	250
	L (I)	5⅞	5⅛	87	⅞	66	320
	S (II)	2⅞	2½	87	¾	77	275
"Delicious/Warren" (3/7),	L	5⅞	5⅛	87	1⅜	77	345
	S	3⅝	2⅞	79	⅞	68	80
"Hubbard/Delicious" (1/3),	L	4⅛	3⅝	87	1	76	285
	S	1⅞	1⅝	87	⅝	78	145
"Cocoanut" (19),	L	¾	11/16	96	¾	81	165
	S	⅜	5/16	90	½	82	65
"Delicata" (32),	L	3⅛	3	96	⅞	80	145
	S	1⅝	1½	92	¾	73	260
	L	⅞	13/16	93	9/16	71	150
	S	⅜	¼	67	½	99	55
"Perfect Gem" (43),	L	15/16	⅞	93	¾	82	235
	S	½	7/16	94	11/16	84	150
"Fordhook" (38),	L	1⅓	1¼	97	11/16	84	210
	S	11/16	10/16	94	⅝	84	155
"Michigan Mammoth Pumpkin" (48),	L	10¾	9⅞	92	1⅛	80	530
	S	4	3⅝	91	1	70	465
"Field Pumpkin" (46),	L	13	12½	96	1½	73	640
	S	11¾	11	94	1⅜	73	560
"Sugar Pumpkin" (49),	L	6⅞	6¼	91	1⅜	77	500
	S	2⅞	2⅜	83	1⅛	78	430
"English Vegetable Marrow" (36),	L	3⅛	2⅝	84	⅝	62	225
	S	1⅝	1½	92	⅝	77	210
"Italian Vegetable Marrow" (41),	L	4⅝	4¼	92	¾	77	485
	S	2⅛	1⅞	90	½	76	160
"Winter Crookneck" (18),	L	10	9	90	1	82	415
	S	4	3½	87	½	87	215
	L	8¾	8⅜	96	.....	80	.....
	S	5½	5	91	.....	82	.....
	L	9¼	8¾	95	¾	77	390
	S	6⅞	6½	95	¾	80	350

The data presented above may help in comparing the different varieties of squashes. The soil where the squashes grew was very poor, consequently none of the plants were at their best.

While there are exceptions, the table above shows that, in general, the larger fruits (marked *L* and alternating with *S* for small) within the variety have the larger percentage of flesh as compared to the whole weight of the fruit; it also shows that the percentage of flesh in volume as compared to the whole squash varies with the thickness of the flesh.

The squashes in the above table can be divided into the following groups: (*a*) the true *Cucurbita maxima;* (*b*) the small *C. Pepo,* like "Cocoanut," "Perfect Gem;" (*c*) the large *C. Pepo,* like the true pumpkins; (*d*) the long *C. Pepo,* like the "English Vegetable Marrow," and (*e*) the *C. moschata.* The percentage of flesh is highest in group *b* and followed in order by *c, e, a* and *d*. Likewise, the solidity of flesh is highest in *b* and followed in order by *e, a, d* and *c*.

A study of the numbers of seeds shows that, with five exceptions out of thirty-four instances, the larger fruit contains the greater number of seeds; furthermore, the seeds of the latter are larger. In other words, the larger of the two squashes upon the same vine contains the larger seeds, and generally more of them.

In Plate XXI. is shown ten pairs of samples of squash seeds. The ten seeds from the smaller squash of each pair from the same plant are placed, in each case, to the right of those from the larger fruit, and the record number below the pair shows what variety or cross is represented.

At 3/1 is the set of the "Delicious/Hubbard" cross, and the difference in size is evident. There are two sets of the "Delicious/-Golden Hubbard" (3/4) cross and, in addition to the difference in size, there is a marked variation in shape. The next, "Winter Crookneck" (18), is a representative of the *Cucurbita moschata* with a decided change in the type of seed, but here the rule is regarded that the smaller fruit has the smaller seed. In the "Cocoanut" (19) the fruits are, at best, very small and the larger yields the much larger seed. The "Fordhook" (38) shows seeds similar to the last with the result as to correlation of size of fruit to that of seed fully maintained. At 41 is the representative of "Italian Vegetable Marrow;" at 43, "Perfect Gem," and at 48, "Michigan Mammoth Pumpkin," three of which show

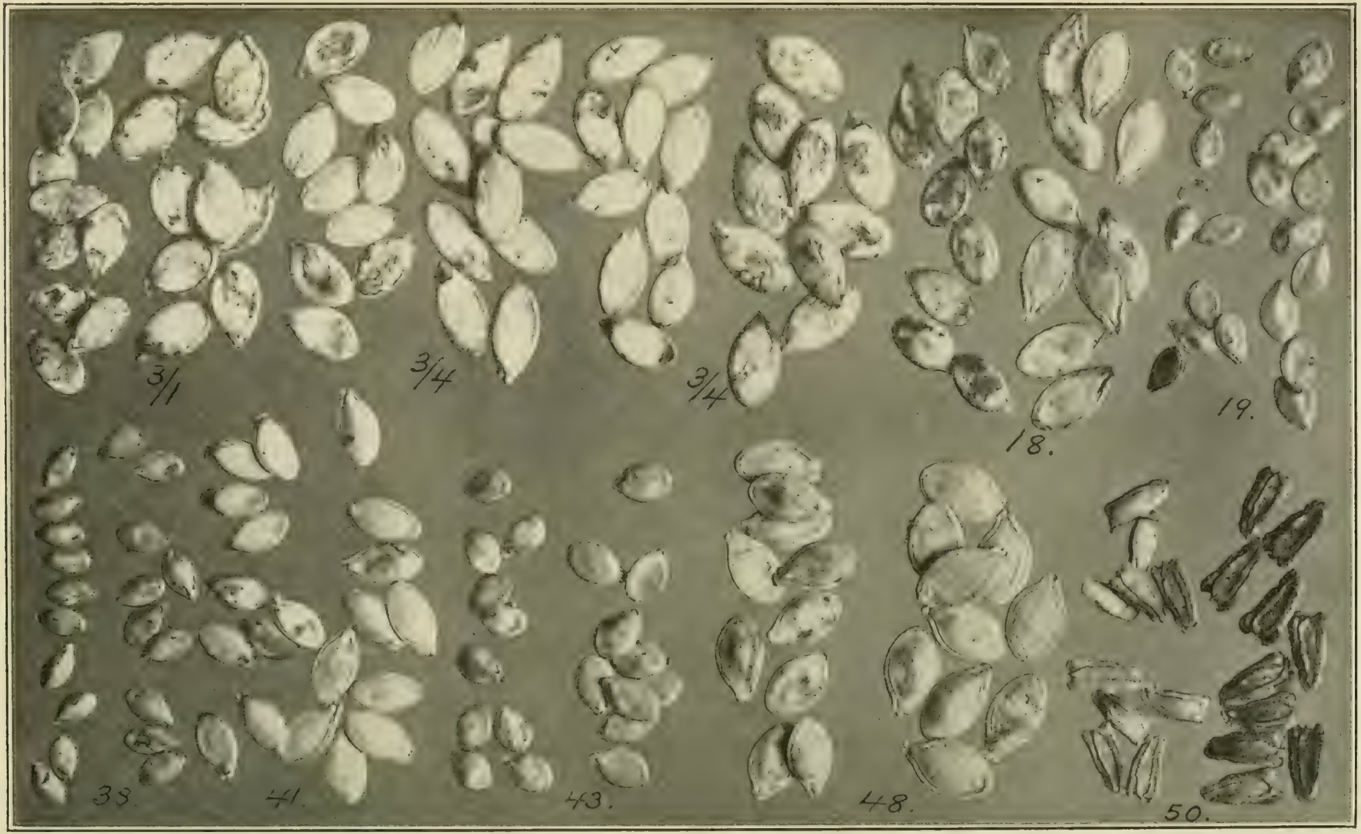
3/1
3/4
3/4
18.
19.
38.
41.
43.
48.
50.

PLATE XXI. *Squash Seeds.* Sets of ten seeds each in pairs from large and small fruits of same kind, showing that the larger squashes produce the larger seeds.

a wide range in size, but the same correlation. The last pair of ten seeds is of a gourd, "Chinese Bottle Gourd" (50), in which the seeds are smaller from the smaller fruit as shown elsewhere.

Out of thirty-four instances examined there were only four exceptions, and in these the size of the seeds was either practically alike in the two fruits or only a slight variation from it.

In connection with the thickening of the flesh the problem of seed content is not to be overlooked, and facts are to be sought that may throw light upon the improvement of the variety, both in greater percentage of food in the fruit and vigor of the plant that produces it. In other words, the selecting for thick flesh may, in a measure, be a selecting of the fruits with low seed content, and a fruit that produces but few seeds may give them better conditions for a superior development that shows itself in stronger plants. An inverse correlation may exist between flesh content and seeding capacity, which carried a step further may mean better equipped plants from the seeds of thick-fleshed fruits.

Reports from Testers for Station Winter Squash No. 2; Delicious—Bay State (3/21).

"Have seven healthy plants." "Foliage is heavy, fruits assorted sizes and colors and of various shapes, oval; pointed at one end; flat and round and some slim and tapering. Colors vary from drab, dark green, to light green and yellow. One is now ripe and is of a reddish tinge. It was yellow when growing. Fruit is now setting in abundance." "Vines made a rank growth, fruit set fine, color light green. Shape like a bowl." "Germinated well. Plant vigorous. Fruit plentiful in numbers and quite uniform in size." "The plant is good size, quite productive." "My winter squash is very nice and productive, as many as ten squash on a plant of good size and uniform color." "The vines are very productive, spreading quite a distance and bearing fruit of medium size." "Color yellow, shape almost round, some oval, doing well." "It did very well, medium size and vigorous grower." "Very hardy and productive. Made a good growth where 'Hubbard,' grown on same ground, failed on account of borer and adverse weather conditions." "Squashes were not very large but nice size for small family; the quality is fine, much like the 'Hubbard.'" "The squashes are both long and flat in shape. The vines are quite productive, although the squashes are all very small, about two to four pounds each. Quality first class, very sweet, dry and fine-grained." "Size small, a very vigorous grower and very productive." "Flesh deep yellow, very thick and made excellent pies." "Healthy vine, very prolific, small fruits, solid, small seed cavity, extra fine quality." "The winter squashes are the finest I ever had, grew to a fair size, all uniform and a good color. I am much pleased with them."

Varieties of Winter Squashes Not Before Grown in the Gardens.

No. 34. "Chicago Orange Marrow." Resembles the summer "Crookneck."

No. 35. "Chiloe, or Sugar Squash." All plants died before bearing.

No. 36. "English Vegetable Marrow." Fruits long or oval, light yellow or striped.

No. 37. "Faxon's Brazilian." The "Hubbard" type, green, yellow or orange.

No. 38. "Fordhook." Resembles the summer "Fordhook."

No. 39. "Green Mountain." No crop.

No. 40. "Heart O' Gold." No fruits matured.

No. 41. "Italian Vegetable Marrow." Fruits long, dark with green stripes.

No. 42. "No. 94." Fruits not uniform in shape, all lead-colored.

No. 43. "Perfect Gem." Like "Cocoanut," but have no stripes.

No. 44. "Sibley, or Pike's Peak." Fruits like "No. 94" in form and color.

No. 45. "White Congo." No crop.

PUMPKINS.

No. 46. "Field Pumpkin." Large, long or oval, orange-yellow.

No. 47. "Mammoth Red Etampes Pumpkin." No crop.

No. 48. "Michigan Mammoth Pumpkin." Large, spherical, reddish-yellow.

No. 49. "Sugar Pumpkin." Medium size, but resembles No. 48 in other respects.

No. 54. "Sweet Potato." Large and very long, dark with green stripes.

No. 55. "Mexican Pumpkin." No crop.

GOURDS.

No. 50. "Chinese Bottle Gourd." As the name suggests, its shape is like a bottle.

EXPERIMENTS WITH PEAS.

Several sets of pea crosses that had been carried through their first generation from the blend plants last autumn were continued during the spring months. A large part of the details of these trials will be left in the record books for the present, but something concerning a single combination is noted below.

Second Generation of "French Canner-American Wonder" Cross (41/4).

Following the tentative classification of the one hundred and twenty-seven seeds of one of the plants of this cross, peas were planted of the eight combinations given below:

Smooth,	Cream,	Large.
Smooth,	Cream,	Small.
Smooth,	Green,	Large.
Smooth,	Green,	Small.
Wrinkled,	Cream,	Small.
Wrinkled,	Cream,	Large.
Wrinkled,	Green,	Large.
Wrinkled,	Green,	Small.

At harvest time, all eight groups were represented excepting the last one, of which there were only two seeds at the outset. The record shows that the dwarf plants were limited to two with one that showed a form and size midway between the dwarf and standard plant. This is far below the number expected under the Mendelian rule, but, as the harvested plants were only twenty-four, the number is too small for any close approximation. It is found that peas are not an easy subject for the study of seed characteristics when the whole output of a plant is included. For example, the question of size, color and smoothness are decidedly modified by age, and when any pods are even a little immature the peas are classified with difficulty. Much more work is needed to warrant any conclusion as to whether size is among the unit characters. There seem to be several, for example, as to size, shape, form and color of pods.

In the cross in question, the "American Wonder" is a dwarf variety with medium-sized pods and large, green, much wrinkled seeds, while the "French Canner" is a standard sort with slender stem, bearing small pods and small, light or flesh-colored smooth peas. The contrasts are many, and the cross, therefore, involves striking differences.

So far as the whole plant is concerned, the "French Canner" has controlled the size, and a large plant, as a rule, may be expected from the cross with only an occasional dwarf plant (possibly one in four) appearing among the offspring of the standard plants. In the size of the pods, the "American Wonder" has had a very marked influence, but the data are too limited for the exact value of each parent to be determined for the present.

The eight plants that grew from wrinkled seeds all produced wrinkled seeds without exception. In the set in this group, in which the seeds were cream colored, there were 75 green seeds in the total of 408 peas, and from the two plants grown from green wrinkled peas, the seeds (76) were all green, but the shade differed strikingly in the two plants, although constant in the respective plant.

Of the sixteen plants grown from smooth seeds, one was weak, and its seeds were rejected. The following results were obtained from the test:

Smooth,	Cream, Large,	114
Smooth,	Cream, Small,	107
Smooth,	Green, Large,	125
Smooth,	Green. Small,	2
Wrinkled,	Cream, Large,	21
Wrinkled,	Cream, Small,	5
Wrinkled,	Green, Large,	34
Wrinkled,	Green, Small,	0

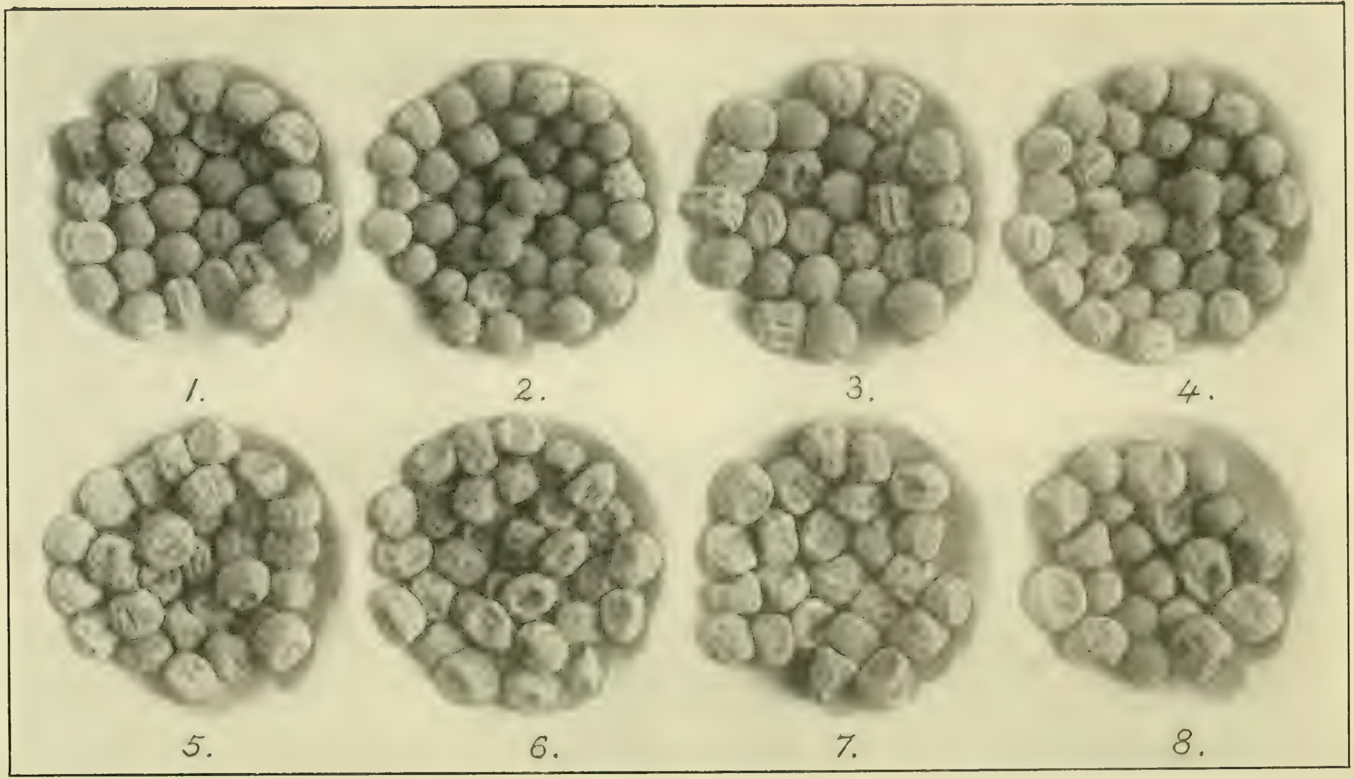

Plate XXII. *Crossed Peas.* Several combinations of "French Canner" upon "American Wonder" are shown in the first seven pits of the artist's dish, with both the parents, represented by ten seeds each, at 8.

Disregarding the size on account of the difficulty of discrimination, the table is reduced to:

Smooth,	Cream,	221
Smooth,	Green,	127
Total,		348
Wrinkled,	Cream,	26
Wrinkled,	Green,	34
Total,		60

In Plate XXII., the seeds from a plant grown from a smooth, light, large pea are shown at 1; they are of average size and both smooth and wrinkled, light and green. At 2 is a similar set from a smooth, light, small seed and it is observed that the size is decidedly less than in any other dish in the plate; the smooth peas being easily mistaken for the pure "French Canner," samples of which with the other parent of the cross are shown at 8, ten of each. At 3 is a sample of the result of a smooth, green, large pea and all the seeds are green and large but the smoothness is not so apparent as in the previous dish. At 4 are the seeds representing the output from a smooth, green, small seed and it agrees closely with that for dish 3, all being green but somewhat smaller. At 5 is shown a sample of seeds that came from planting a wrinkled, light, large seed and it is seen that the peas are all wrinkled and large with twenty-five per cent. of green seeds. The next dish (6) contains peas resulting from the planting of a wrinkled, light, small seed and the set photographed is practically the same as that shown at 5, with some diminution in size. The set at 7 is from a wrinkled, green, large pea and all the offspring resemble the parent fully. At 8, for purposes of comparison, the two parents of the cross are given.

It is too soon to predict the possibilities of this combination, and the lines to be followed further depend upon the end sought. If one desires a small seeded early plant, it may come out of the lot represented in dish 2, when the wrinkled peas will give a truly sweet sort and, if the size is the main thing as with some growers for the canneries, the smooth peas may give the desired end, namely, a prolific quick-growing kind that yields its small peas all at once to accommodate itself to the modern method of harvesting with a thresher. For home use, it is possible that an acceptable sort may be derived from the lower row of dishes, especially should the plants be half-way standard or medium in size and not require brush or trellis.

Autumn-Grown Peas.

The less said the better is one way of considering the growing of peas during autumn. A block of thirty-two hills was planted to peas after the removal of a crop of "Malamo" corn in August. While aware that peas did not like the hot weather of midsummer, there was hope that by the time seedlings were in their first leaves, the cool nights and shorter days of autumn might bring a crop and thus add one generation to the cross. The peas used for planting were freshly grown in a spring crop near by, and consisted of the second generation from the blend of "French Canner" upon "American Wonder" (41/4). Nineteen hills received smooth, cream-colored seeds; six received wrinkled cream-colored; four, smooth, green, and three, wrinkled green seeds.

As before stated, the "French Canner" is a tall, slender, late variety with small, smooth cream-colored seeds, while the "American Wonder" is a dwarf early type, bearing comparatively large, wrinkled green, or "bluish" peas. The following table gives the results as to size of plants, the crop being so small as to be a negligible quantity:

	Dwarfs.	*Standards.*	*Medium.*
19 hills,	17	25	14
6 "	4	9	3
4 "	2	2	1
3 "	2	3	2
32	25	39	20

Even with the "medium" being included with the "standard," there is a high percentage of the "dwarfs."

A second block of ground (where thirty-two hills of "Malakosby" corn had been harvested) was planted with peas at the same time as the one above noted but the crosses here were different and no crop was secured.

A shade experiment was made with a few hills of peas by placing them between widely separated over-arching trees, but only an occasional seed was the reward. The hope of growing peas to a liberal fruiting, other than in the spring, hangs by a slender thread and work with other crops in midsummer is too pressing to spend time in nursing any one kind unduly out of season.

EXPERIMENTS WITH SALSIFY.

Upon August 25th (1906), the following rows of three hills each (four by four feet each way) were planted in the lower part of Plot 4, Series II.:

Row 1. This was planted with seeds formed under bags of the pure yellow wild type (*Tragopogon pratense*). The plants all came true.

Row 2. This was planted with seed from protected heads of darker red orange (Prang, No. 31), and the plants produced a set of blooms of the same color combination.

Row 3. This set of three hills was planted from bagged heads of plants of 21–y, dark red red orange and reproduced the parent type with much uniformity.

Row 4. This row contained plants fertilized within the head of the red violet (No. 233), which adhered closely to the parent color with some "yellow-eyed" heads.

Row 5. The plants here were somewhat variable in shade but within a narrow range and proved no marked exception to the rule.

Row 6. This was a duplicate of row 5.

Row 7. This set of hills was planted with seed from protected flowers of the light red violet (No. 234) type and came true to the parent color.

Row 8. This row was planted with "suspect" seed of garden upon "Black" salsify, but all the plants were of the latter species.

Row 9. This was an attempt to get a reciprocal of the last-named, but all the plants were the pure garden type.

Row 10. Here an attempt was made to breed the "Black" upon the wild species but the result was a failure.

Row 11. This row was occupied with a set of the "Black" salsify for the purposes of further attempts at breeding.

The test of the present year illustrates that close breeding, that is, within the plant and more within the head, is sufficient to perpetuate the particular shade of the parent among hybrids that have been selected somewhat at random from many color types.

The union of two species of salsify, both with very uniform and widely different colors of the bloom, results in the production of a great many shades in the flowers of the hybrids. It seems probable that any one of these may be fixed with much ease by simply limiting the fecundation to the plant carrying the shade it is desired to perpetuate.

Because of the unusual difficulties that have beset the experiment from its beginning some years ago and the lack of direct practical results the work with salsify is for the present set aside. Anyone, however, who wishes to make a study of the floral colors of hybrids can find few better species for that purpose than the wild and garden salsify, provided the weediness of the crop is no disadvantage and birds can be kept from the plants at the time when the heads are maturing their fruits.

EXPERIMENTS WITH OKRA.

The plan was laid to grow a full set of the okras the present season and begin a systematic breeding of the various kinds, a classification of which was given in the last report (pp. 501, 502), but the seeds gathered in from various sources quite generally failed. One is not certain of what he has as a basis for breeding operations in truck crops until he has tested it for some years, and this seems to be particularly true with okras. It is possible that the usual care taken by the best seedsmen to have their goods true to name does not bring the desired results with okra, and it may be that the plants themselves are largely at fault. The subject certainly demands study, as it does more consideration from the hands of the practical grower. Be this as it may, the work upon the plot of okras the present season casts a doubt as to the reliability of the names of some of the parents, and, therefore, upon the real significance of many crosses that were secured. The "Dwarf Prolific," for example, was a standard, and "Lady Finger" had pods ranging from very short to long.

A photograph was taken of four kinds that were represented by several plants each, namely, "Lady Finger," "Perkin's Long Pod," "White Velvet" and "Kleckley's Favorite," but it seemed best to withhold it from publication until a better representative set could be secured.

"PAK-CHOI" AND "PE-TSAI."

These quite similar Chinese vegetables were grown somewhat extensively in the Home Grounds in 1906 and reported upon with a plate last year (Plate XXV.). Seed was saved from some of the plants and distributed to several growers of truck crops for a practical test.

The reports which follow are generally to the effect that the plants are quick-growing and hardy and are inclined to "run to seed." From our limited experience, this is true of the early crop, but when the seed is sown in midsummer the plants make large development of the edible leaves without any show of flower stalk. The "Pak-Choi" is very resistant to frosts, and, at the time of writing (November 1st), large plants are in full vigor in spite of cold nights that produce much ice. It is as a late autumn crop that this vegetable is of greatest use, and, as such, shows much merit. It does not seem to be attacked by the ordinary enemies of Brussels Sprouts and its cabbabe-like allies.

Reports from Testers for "Pak-Choi."

"Vigorous and productive. At this writing (Aug. 14th) plants average eighteen inches high, and a few are just running to seed, or rather beginning to bloom. Planting was not made until June 15th. In early stages or when blanched, is fairly good for salad, or passably good boiled for greens, its quick growth being in its favor." "Plants about twelve inches high, of rapid growth." "Growth rapid, leaves light green." "This seed was planted early and has now gone to seed. It grew rapidly and was thrifty, and has a considerable quantity of seed." "Weather conditions extremely bad, cold, dry, or very cold rains. 'Pak-Choi' seemed to thrive, however, when other things stood still." "The plants are strong and vigorous." "The plant is with us very vigorous and productive. We grew it on muck ground. The unused plants are now ripening seed. We have a summer boarding-house. Our boarders were pleased with this vegetable and generally voted that in flavor it was suggestive of Brussels Sprouts. We served it in a cooked state." "Height about twelve inches, quick grower. Volunteer plants have come up from seed self-sown." "A very vigorous plant." "Found 'Pak-Choi' very hardy, thrifty and a strong grower." "Planted June 11th, first mess July 22d, when it was already very large. It perhaps has its place being very hardy, thrifty and of quick growth but I cannot say that we care for it."

Reports from Testers for "Pe-Tsai."

"Growth very vigorous, four to five inches tall when in seed. Root, of turnip shape, about two to two and a half inches largest diameter, and perhaps three to four inches long to tip. Flavor resembling kohlrabi." "Large size and vigorous growing plants, two or three crops can be grown on some ground in one season and large crops. "Twenty inches high, well leaved out, seed very fertile, plants thrive when wet and grow slowly but healthfully when droughty." "Similar in form to 'Pak-Choi.' " and makes a good 'Greens' not as thick-leaved as 'Pak-Choi.' " "In regard to 'Pe-Tsai,' the plants were set out on the 15th of May and were not affected by frost. The plants matured the first week in July Height about eighteen inches, width of leaves four inches. In going into seed, it measured thirty inches in height. In preparing for the table, it tastes like 'Swiss Chard' or spinach." "This grew well on my grounds and I found the greens a very welcome addition to the bill of fare, both cooked, and green. I shall have plenty of seed to plant more extensively next season and look for even better results, as this year has been a very trying one for all vegetables, and anything that did even half well under such unfavorable conditions has certainly proved its value." "Identical in every particular with 'Pak-Choi.' Growth vigorous to six or eight leaves, then big seed stalk; used younger leaves for cooking, two or three picked from each plant." "Grows about five feet high, only two plants thickened to a head, but grew up at once to seed. Of the two that headed one was cut and has formed a group of heads. The plant is a vigorous grower and of good flavor." "It has large leaves, broad and eight or ten inches long, tops long." "Came up well and grew very luxuriantly, tender and fine. Some of it grew to the height of four feet." "Large. vigorous, much like mustard." "Made rapid growth and when four inches high was tied with raffia to bunch. Made a fair table salad." "A very vigorous, hardy plant and should be a valuable acquisition."

EXPERIMENTS IN THINNING.

As an aside from the regular work, some tests were made in thinning. For example, one plant in each of the eight hills of a row of "Kelsey" and of the "Station" Bush Lima beans had a half of its pods removed while they were small, the older pods only being retained. These plants were not in any way selected, but in all respects seemed to be an average set, and they gave the following results:

	Weight of Pods.	Weight of Seeds.	Number of Seeds.
"Kelsey"—			
Thinned plants average, ...	2.25 oz.	1.25 oz.	50
Normal " "	1.73 "	.97 "	48
"Station"—			
Thinned plants average, ...	6.00 oz.	2.50 oz.	60
Normal " "	5.20 "	1.67 "	46

It is seen that the results are decidely in favor of the thinned plants, the weights of seeds being in the ratio of 375 to 264, or a gain of more than one-third. There was a gain also in a larger percentage of mature seeds, but, as it is practically impossible to separate the mature from the green seeds, the exact figures in this respect are not at hand. The number of seeds was larger in both cases for the thinned plants, but the cause is the same here as elsewhere, as, for example, when orchard fruits and other kinds are thinned. The plant, left to its own devices, was not able to hold as many pods as where a half or less received the motherly attention that was elsewhere divided among a great number. It is likely that the thinning of the plants for the production of the seeds for future plantings might result in profitable results, but in general field culture the process is not expected to be employed.

A set of plants of "Hyacinth Bean" *(Dolichos Lablab L.)*, which grew with great vigor and bloomed most profusely, offered an opportunity to test the effect of thinning, but, in this instance, within the single flower clusters which normally may mature eight or more pods, as shown at 1 in Plate XXIII. In the thinning sometimes the oldest (lowermost) bloom or young pod was left as at 2, or the middle one as at 3, or the youngest as at 4; in the last, however, a middle pod was also reserved. One of the most noticeable features with this test was the hastening to maturity of the isolated pods; thus, upon two similar clusters, one thinned and the other not, the pod upon the former became dry and the seeds hard before the normal cluster showed any signs of maturity. At 12 is shown an instance where the flowers were all removed from the main axis and afterwards a short stem formed below, which bore five large pods. In 15, the flower buds at one joint only were left and these developed into five large pods, where normally one or two are produced; in other words, the natural thinning probably was interfered with.

There does not seem to be any increase in the size of the pods or weight of the seeds ascribable to this process of thinning and the relative strength—vigor, variability, etc.—of the seeds thus produced is a matter for later consideration.

EXPERIMENTS IN GRAFTING.

During the past winter, some attention was paid to grafting among vegetables in the greenhouse. The methods consisted in growing two plants near together in the same box, or in separate pots, and at a foot or so above the soil, a "tongue" was made on each plant by a slant incision into the stem, the one upward and the other downward, the two then being united by mutual insertion and the joint covered with moist moss and tied with raffia. In this condition, the two plants were allowed to remain until the joints grew together, and then the plant selected as the scion was cut off below the union. The resulted graft, trimmed of its unnecessary parts, was kept erect by fastening to a support.

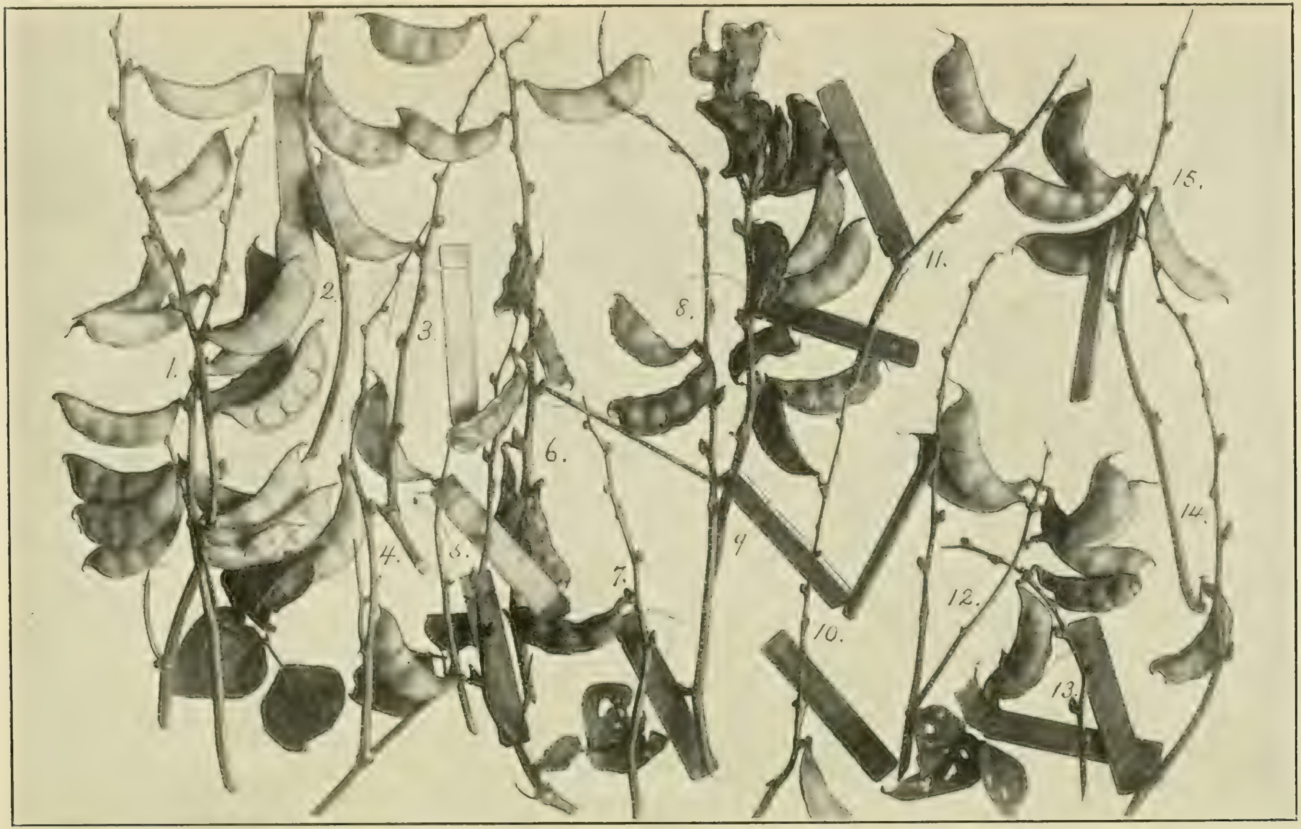
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Plate XXIII. *Hyacinth Bean.* Illustration of the effect of thinning within the Flower Cluster.

While no definite statement can be given as to the ages of the plants grafted, the rule was to have the plants old enough to withstand mutilation and yet young enough to insure rapid union.

Tomato upon "Garden Huckleberry" (*Solanum nigrum*). The attempts gave one success. The graft rapidly increased in height, but its foliage was scant. It was set out in the field where it lived until the middle of August, having time to produce one fruit which was an inch in diameter. The seeds were many, and when started grew vigorously. No effect of the "Huckleberry" stock was noted.

'Garden Huckleberry" upon Tomato. Two attempts gave one success. The graft was vigorous and, when set out in the field, it grew until the autumn frosts. The scion and stock both produced an abundance of their own kind of fruit. Seeds were many in every fruit and produced seedlings rapidly. No effect of tomato stock upon "Huckleberry" was noted.

Tomato upon Eggplant. Two attempts gave no success.

Eggplant upon Tomato. Two attempts gave one success. The graft at first was not vigorous, but when set out in the field it grew well and matured many tomato fruits and one eggplant fruit; the latter was small and its seeds started well. No effect of eggplant upon tomato was noted.

Tomatoes: Fine-Leaf and Coarse-Leaf. Eighteen attempts were made to graft tomatoes: Nine fine-leaved upon coarse-leaved, and nine reciprocals. While all the grafts started, two were weak and died within a month; only nine out of the sixteen were fit to go into the field and, within a week, two died, leaving seven grafts that grew vigorously throughout the season. These grafts represented five coarse-leaved upon fine-leaved, and two reciprocals. Only one graft-plant (a fine- upon a coarse-leaved) showed the effect of the union; the leaves from stock and scion were the same and not as coarse nor as fine as the foliage of the original parents.

SMALL CAPSULES WITH HYBRID SEEDS.

A few plants were grown of three species of Daturas, namely, *Datura Stramonium, D. Tatula* and *D. Meteloides* for purpose of hybridization.

Shortly after the floral parts fell away, it was noted that the capsules that were resulting from the pollination of the *D. Meteloides* upon either *D. Tatula* or *D. Stramonium* were much less rapid in growth than those that were pollinated in the open. This difference continued to increase until the time of harvest when the capsules from flowers treated with *D. Meteloides* pollen were only a quarter or less the size of the others upon the plants. In Plate XXIV., seven branches are shown, five upon the left of *D. Stramonium* and the two to the right of *D. Tatula.* The capsule with the label, in each case, is from the hand-worked flower and those nearer the tips of the respective branches were formed later. The comparison should be made with the largest of these younger capsules and this will show that there is quite a uniform difference as above mentioned.

The seeds were very few in these small capsules; thus, of the *D. Stramonium,* one had no seeds; the next, five; the third, three; fourth, five; and the last, two; or a total of fifteen seeds—that is, an average of three seeds per capsule. The results were even smaller for the *D. Tatula* capsules, as one had only several half-grown seeds and the other one plump seed and a few imperfect ones. The seeds in normal capsules of the two species average near six hundred.

The Daturas are readily close-fertilized, as shown elsewhere under exclusion experiments, and, in making a cross, the flower needs to be worked some days before the long corolla unfolds.

EXCLUSION EXPERIMENT.

As the work of breeding has been pursued, the desire for further information concerning the self-fertility of flowers of various truck crops has grown, and during the present season

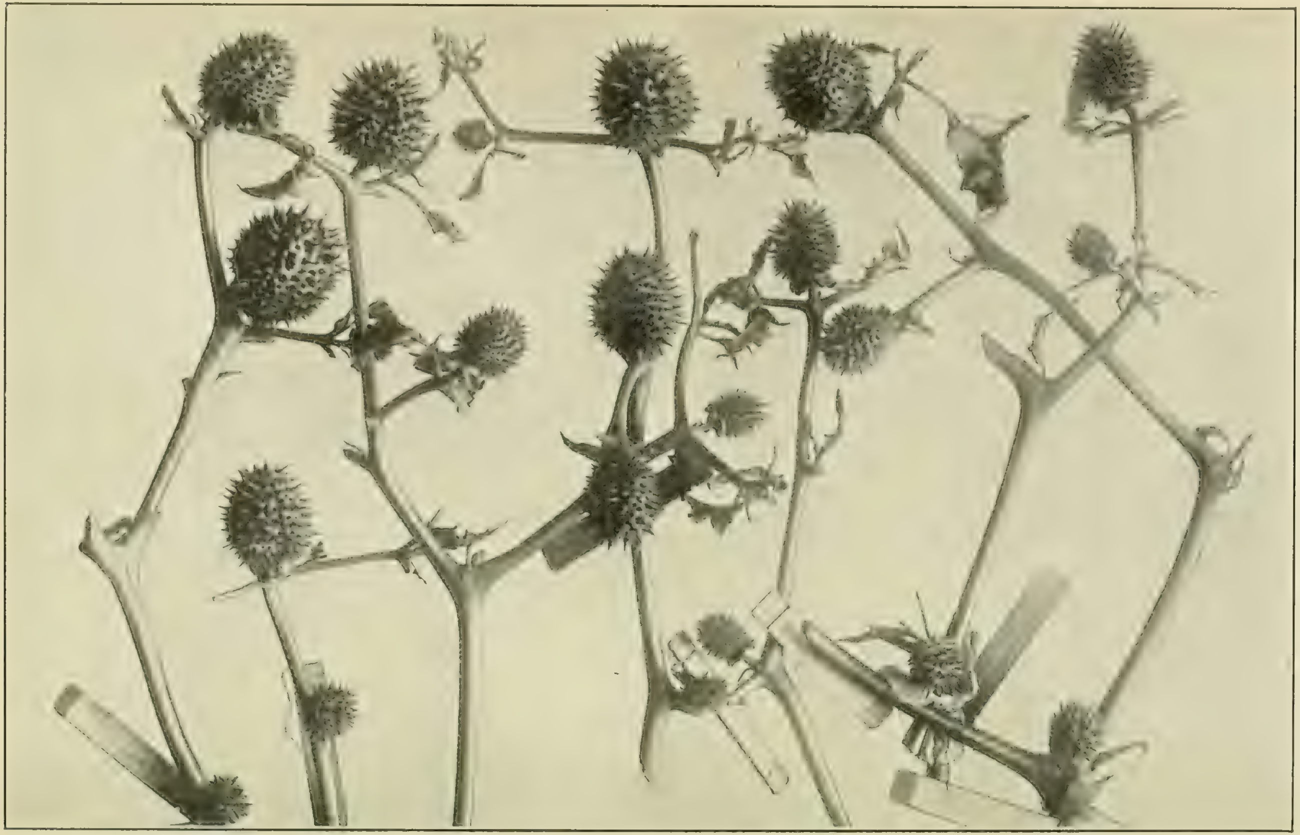

PLATE XXIV. *Datura Capsules.* The small capsules with labels are nearly seedless and result from the preliminary steps in hybridization.

the opportunity was taken for a study of this subject. The method adopted is the simplest, consisting of the isolation of flower buds from all their fellows by means of paper bags and making a record of the results. For ease of computation and to insure a working basis for any possible conclusion, the number of instances in each case was limited to not less than one hundred in eggplants, tomatoes and morning glories, and fifty in daturas.

The preliminary work of exclusion is not particularly tedious, but needs to be done with much care, or else in many instances a second bud, still quite small, may be overlooked and the instance be not above suspicion. In tomatoes, for example, two or three buds may bloom so nearly simultaneously that only the most careful work at this point in the test is effective. The check upon accuracy that is found in the presence of two fruits forming when only one is intended and thus nullifying the particular instance, should not be relied upon, for all flowers in a cluster do not necessarily produce fruits.

The test is easy with eggplants, as here the flowers are large, but few in a cluster and simultaneous blooming not the rule among flowers of the same inflorescence. Morning glory flowers are so large and the buds so conveniently placed as to render the experiment easy at the start.

Eggplant Exclusion Experiment.

From the one hundred flowers employed for the exclusion experiment, ten fruits resulted, varying from three to six inches in length. Five of these, and averaging equally large with the other five, were seedless. The seeds of the latter were not counted but they were not one-tenth as numerous as in those following normally situated flowers.

This test of very limited extent suggests that eggplant blooms are not, as a rule, close-fertilized, and also that fruits of marketable size may be produced that contain no mature seeds, a fact that is not new, but one that has its bearing upon the subject of seedless vegetable fruits.

The small percentage of fruits resulting in this test is probably due to the fact that it was not made until late in the season, when flowers outside of the bags did not generally set fruits. The test will be continued and in season for best results with the hope of learning the effect of such close-breeding upon the offspring of crosses as to the fixation of qualities and also, among commercial varieties, as a test of its weakening tendency.

Tomato Exclusion Experiment.

In order to insure self-fertilization only one bud, before it opened, was allowed to remain on a flower stalk, which was covered with a paper bag to exclude foreign pollen. One hundred buds of nearly the same age were thus covered until the time for fertilization had passed.

In order to compare the number of seeds in the fruits from the self-fertilized with those grown in the open, an adequate number of the latter were harvested from the same plant with the former, and the results are shown in the table below:

	Self-Fertilized.		Fertilized in the open.	
Type of Fruit.	No. of Cells.	No. of Seeds.	No. of Cells.	No. of Seeds.
"Cherry,"	3	45	2	59
	2	28	2	50
	2	37	2	50
	2	49	2	64
	2	58	3	65
	2	46	.	...
	3	33	.	...
	2	24	.	...
	2	12	.	...
"Plum" (Small),	2	109	2	124
	2	105	2	117
"Plum" (Medium),	3	78	2	108
	2	89	2	120
	2	48	2	102
	2	31	.	...
"Plum" (Medium),	2	83	2	140
	2	60	2	89
	2	105	2	92
	2	76	.	...
	2	91	.	...
	2	66	.	...
"Plum" (Cross),	4	66	4	203
	4	98	4	225
"Pear" (Medium),	2	105	2	90
	2	77	2	101

	Self-Fertilized.		Fertilized in the open.	
Type of Fruit.	No. of Cells.	No. of Seeds.	No. of Cells.	No. of Seeds.
"Pear" (Long),	2	69	2	65
	2	45	2	91
	2	64	2	79
	2	64	2	66
	2	96	.	...
"Pear" (Large),	2	80	2	117
	2	92	2	84
	2	67	2	87
	2	31	.	...
Long, oval, medium,	2	84	2	77
	2	57	2	80
	2	66	2	60
	2	81	2	79
	2	72	.	...
	2	59	.	...
Long. oval, medium,	2	58	2	152
	2	95	2	145
	3	105	.	...
	3	97	.	...
	2	97	.	...
Average of 45 fruits,		69	Average 30 fruits,	99

Forty-five per cent. of the flowers covered with bags produced fruits and these are upon ten different crosses, all of the small-fruited sorts. The three crosses that gave no self-fertilized fruits have many cells to a fruit, and this suggests that the fewer-celled fruits are more readily self-fertilized, or in other words, the nearer the fruits are to the wild state the more readily they are self-fertilized. The table also shows that, as a rule, the self-fertilized fruits produce less seeds than the cross-fertilized fruits. Within the cross the size of each fruit showed no correlation with the number of seeds or between the number of seeds and the number of cells.

Datura Exclusion Experiment.

Fifty flower buds of the various daturas were covered with bags, but from these only fifteen capsules were found at the end of the season, and the following table gives the seeds that these bore, and, in the second column, are the results of the counting of the seeds in an adequate number of similar capsules that were not bagged:

Species.	Covered Flowers.	Uncovered Flowers.
D. Stramonium,	395	300
	770	820
	925	875
		1,040
		890
D. Tatula,	830	815
	1,005	915
D. Meteloides,	505	440
	505	520
	520	575
	310	285
	400	330
	530	515
D. Tatula/D. Stramonium,	450	455
	530	505
D. Stramonium/D. Tatula,	675	585
D. Meteloides/D. Stramonium,	395	300
Average,	583	598

It is seen that the seeds formed in the capsules of covered flowers is practically the same as in those for uncovered flowers. It is further noted that the *D. Stramonium* and *D. Tatula* have the same seeding capacity, and that this is nearly double that of the *D. Meteloides.*

Morning-Glory Exclusion Experiment.

Seventy-five capsules resulted from the one hundred exclusion tests among the various kinds of morning glories; some of these were immature and a few were used for greenhouse planting, so that only thirty-four were counted, and these produced 152 seeds, or an average of 4.47 seeds for each capsule. An equal number of capsules grown in the open gave 167 seeds, or 4.91 per capsule, a result that indicates that the morning glories are very thoroughly close-fertilizable.

EXPERIMENTS WITH ORNAMENTAL PLANTS.

Antirrhinum (Snap-Dragon). A blend secured between the "Dwarf White" and the "Giant Crimson" was grown this season, together with the parents. In height they approached the "Giant Crimson," bearing many flower spikes of a lighter red than the

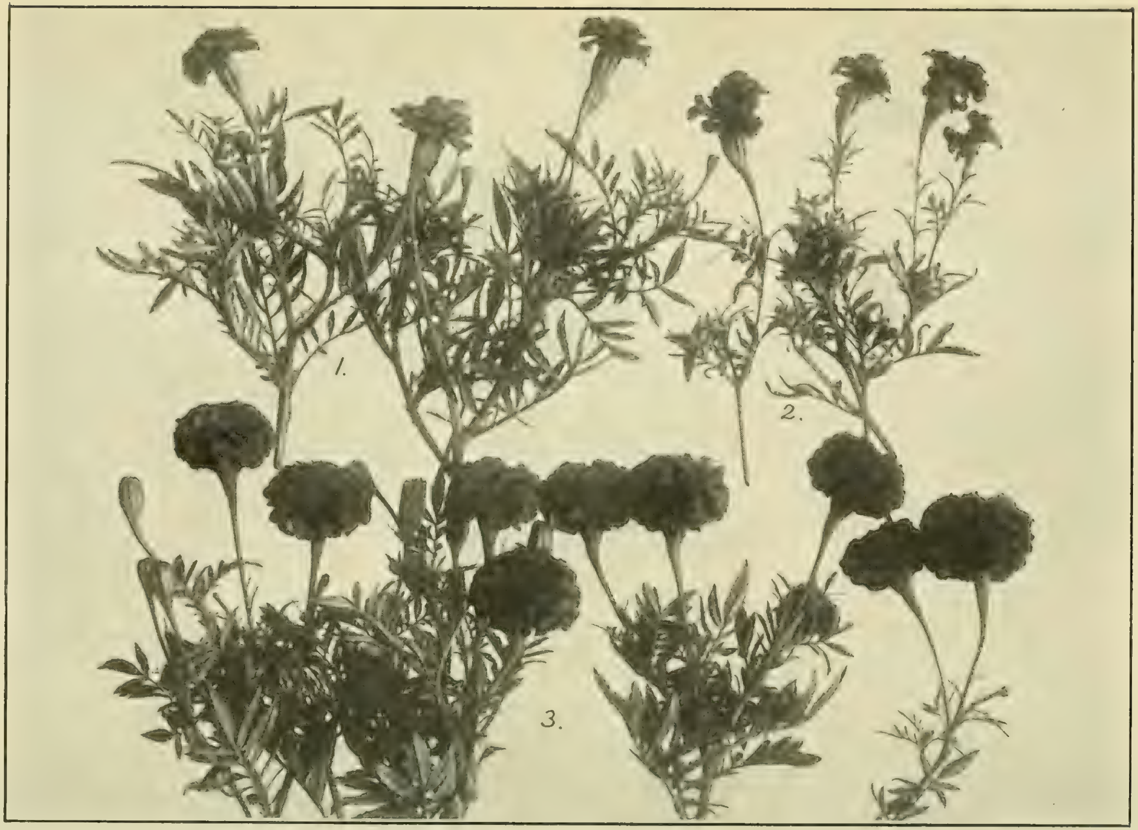

Plate XXV. *Marigold Crosses.* The male and female parents are shown at 1 and 2, respectively, and the cross at 3.

parent, and continuing in bloom the entire season—more profuse bloomers than either parent. Plants of the first generation are now growing at the greenhouse.

Dolichos. One "Suspect" of last year, "Dwarf White/Purple Soudan," has proved to be a true cross. The blend plant was very similar to "Purple Soudan" in climbing habit, purple stem, flower and pod. But three plants were grown of the first generation. Plant 1 was a thrifty, medium climber with foliage, flower and pods resembling the "Dwarf White." Plant 2 showed a stronger climbing tendency, and in foliage and flowers resembled the light purple type of the "Giant Crimson," the pods, however, were white. Plant 3, a climber with purple stem and foliage, failed to reach the blooming period before frost.

Hibiscus. Plants from the suspects Okra-Hibiscus differed in no way from the mother parent. Further attempts have been made to effect this cross, without results.

Ipomeas. Experiments with these interesting climbers have been continued, thirty varieties being grown this season in hills having poles for their support. The attempts at crossing were three hundred and ten, and the number of capsules secured, fifty. It is very difficult to get positive results between species.

The Marigold Cross.

At the greenhouse last winter a cross was secured between the "African" (standard) and the "Dwarf French Marigold." The "Dwarf French" is low growing, compact and spreading, with a dark green foliage of a small type, shown at 1, Plate XXV. It comes more quickly into bloom and produces an abundance of variegated flowers, the principal colors being yellow, orange, burnt orange, and very dark brown, appearing black. In size it is about half as large as the "African" variety, a standard sort of open growth bearing light green leaves, shown at 2.

The blend is a plant (3) resembling the "Dwarf French" in type of foliage and early bloom, but the flower approaches the "African" in size and is orange in color. Blend plants grown in the open began blooming early in the season and were in full flower up to the time of frost. One result of this cross may be a type free from the peculiar odor so disagreeable to many.

The "Pansy-Violet" Hybrid.

Last season a cross was secured between a dark-colored Pansy (1, Plate XXVI.), and the yellow "Violet" (4). The latter has been growing at the Gardens for several years without care, and looks very much like a miniature pansy, having a finer, more narrow-leaved foliage and small yellow flowers, blooming early in the spring.

The blend plants, shown at 2, grown at the greenhouse from the seed started in the fall of 1906, began blooming in March, the flowers having the color of the "violet" but being much larger.

Two of these plants, transferred to the open, bloomed throughout the season until late autumn.

Plants of the first generation from seed sown in July began blooming in September, showing a variation in foliage and shape of flower, but the yellow color still dominated. Two plants produced blooms with purple blotches upon the two large petals and have been marked with the hope of fixing the type. A very hardy, free-blooming pansy is promised by this union, as shown at 3, in the plate.

Field Daisy-Pyrethrum Hybrid.

In 1905, "Suspect" seeds were obtained as a result of breeding together the Pyrethrum and common Daisy, plants from which did not bloom last year, but resembled closely the mother parent. At the blooming period this season the flowers were found to vary in color from the dark red or crimson of the pyrethrum to the white of the daisy. In size some approached the large field daisy, others being smaller with narrower petals, while others bore drooping petals. Seed from the various types has been saved for a study of the first generation plants.

Petunia Crosses.

Several crosses were secured as the result of last year's work, as follows:

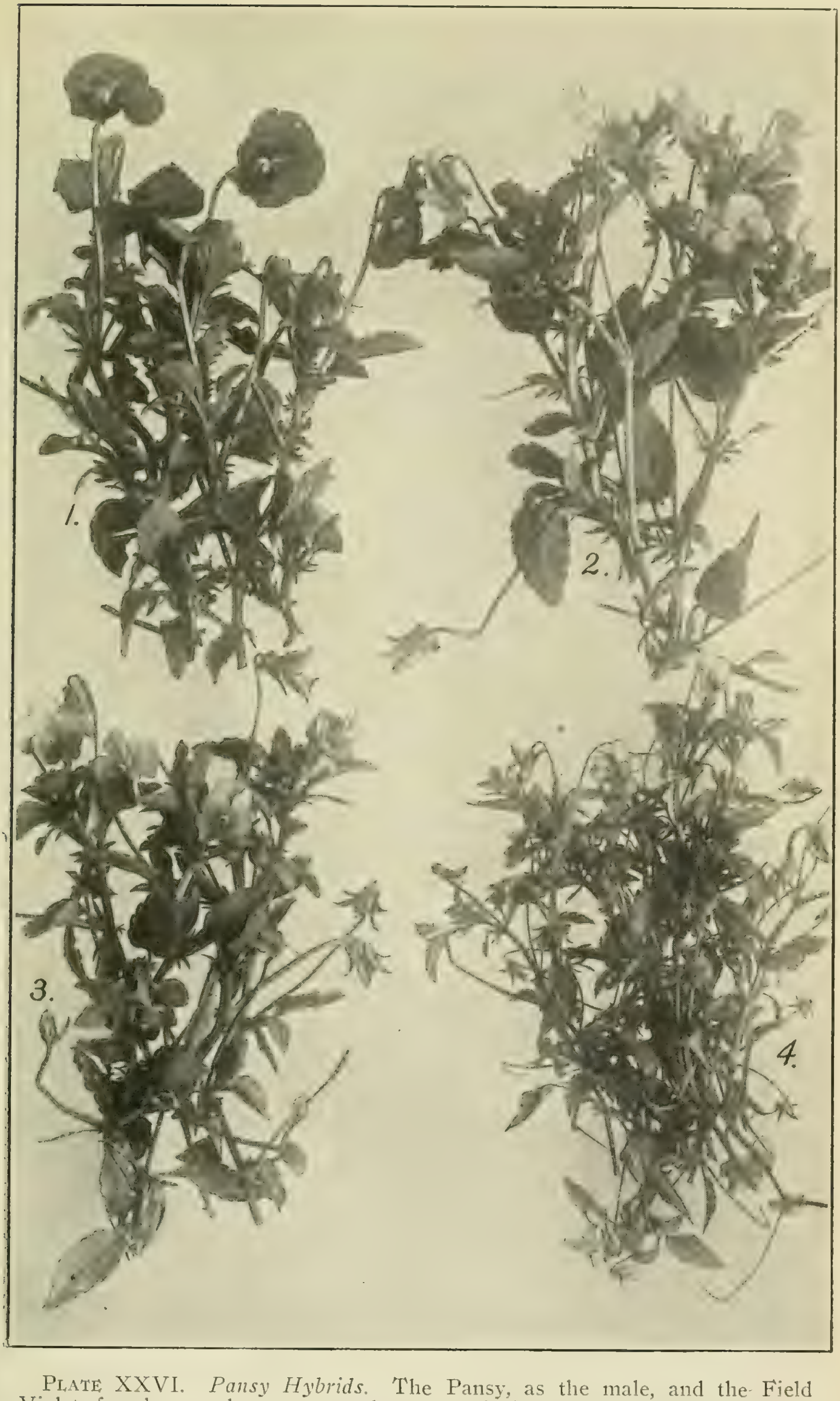

Plate XXVI. *Pansy Hybrids.* The Pansy, as the male, and the Field Violet, female, are shown at 1 and 4, respectively, and the blend plants at 2, and some of the types of the next generation at 3.

"Dwarf Star-Giant Crimson." The blend plants were of rampant growth with foliage a medium between the parents and gave blooms with different shades of crimson, but none were marked with "stars."

"Dwarf Star-Standard White." These were tall growing plants in the blend with lighter shades of the "Star" ground color in the flowers, some blooms showing stripes, others white borders, but no pure white flowers.

"Dwarf Star-Single Fringed." This was an interesting lot of plants, many producing large blooms with broad stripes but none having a fringe.

"Single Fringed-Giant Crimson." These were large thrifty plants with good-sized flowers, mostly of a solid color, lighter than the mother parent. A few plants gave the fringed flower with broad-leaved foliage, pointing to a "Crimson Fringed" variety.

Breeding Among Phlox.

Two or three seeds were secured last year as the result of pollinating the "Red Phlox Drummondii" with the "Perennial Blue," a low-growing variety with a profusion of early blooms. But one plant resulted, which did not resemble closely either parent, being of open growth and producing purplish flowers which in color showed a union of the two parents. This hybrid plant was carefully hand-worked, but failed to set any seed. During the summer it stopped blooming and died down, but it is not certain that the perennial tendency will dominate.

A STUDY OF VARIATION IN PLANTS.

Upon the subject of crop improvement, the variation among plants of the same kind, whether that be species or variety, has an important bearing. This fact has led to the consideration of the range of variation that exists in two of the wayside plants that, in the vicinity of the Breeding Grounds as elsewhere, are perhaps all too common. The "Mayweed" or "Feted Camomile" *(Anthemis Cotula L.)* has served to interest the writer as he walked to and from the grounds to his house, and, one day in October, an hour was taken for the gathering of a set of the heads of this strong-scented weed. A photograph was taken of the collection (Plate XXVII.), the heads being laid down as they were gathered, and, therefore, without any order and no attempts were made to exclude duplicates. In general, the heads are placed with the flowers uppermost as they stand in nature, but a few exceptions to this are made to show the appearance of the involucre as seen looking from below. By glancing along the six somewhat irregular rows, it is seen that some heads are much larger than others, which might be due, in some part, to the age of the flowers and the size of the plant but even in this it was noted in the occasional study of the subject that small heads may be borne by large plants in rich ground while large heads, but few in number, are sometimes produced by small plants that were growing in the hard and poor soil of the roadside. In other words, while unfavorable conditions may dwarf every part of the plant there is, nevertheless, a wide range of variation in the number of the individual flowers and the size of the head of blossoms among plants that are seemingly similarly situated.

Perhaps the part that shows at once the greatest range of variation is in the conspicuous ray flowers. They are more frequently thirteen than any other number, a fact that has been dwelt upon by Professor De Vries in connection with other members of the sunflower family of plants; but in number they vary far less than in their size and shape. It is seen that some are quite short and broad, and need to lap each other at the base, while other heads have the rays long and narrow, with a space between them at the base of nearly their own width; others are flat and deeply notched at the free end, and some are inclined to be "quill" shaped; in fact, a head was found in which the rays were truly tubular, but this is not in the Plate.

In a similar cursory way a study was made of the "wild carrot" *(Daucus Carota L.)*, and samples of the umbels placed in press. This species is very variable in many of its parts, and perhaps no more so in the inflorescence than elsewhere, but it admits more readily of a photographic record. The individual flowers are so small that but little attention was paid to them,

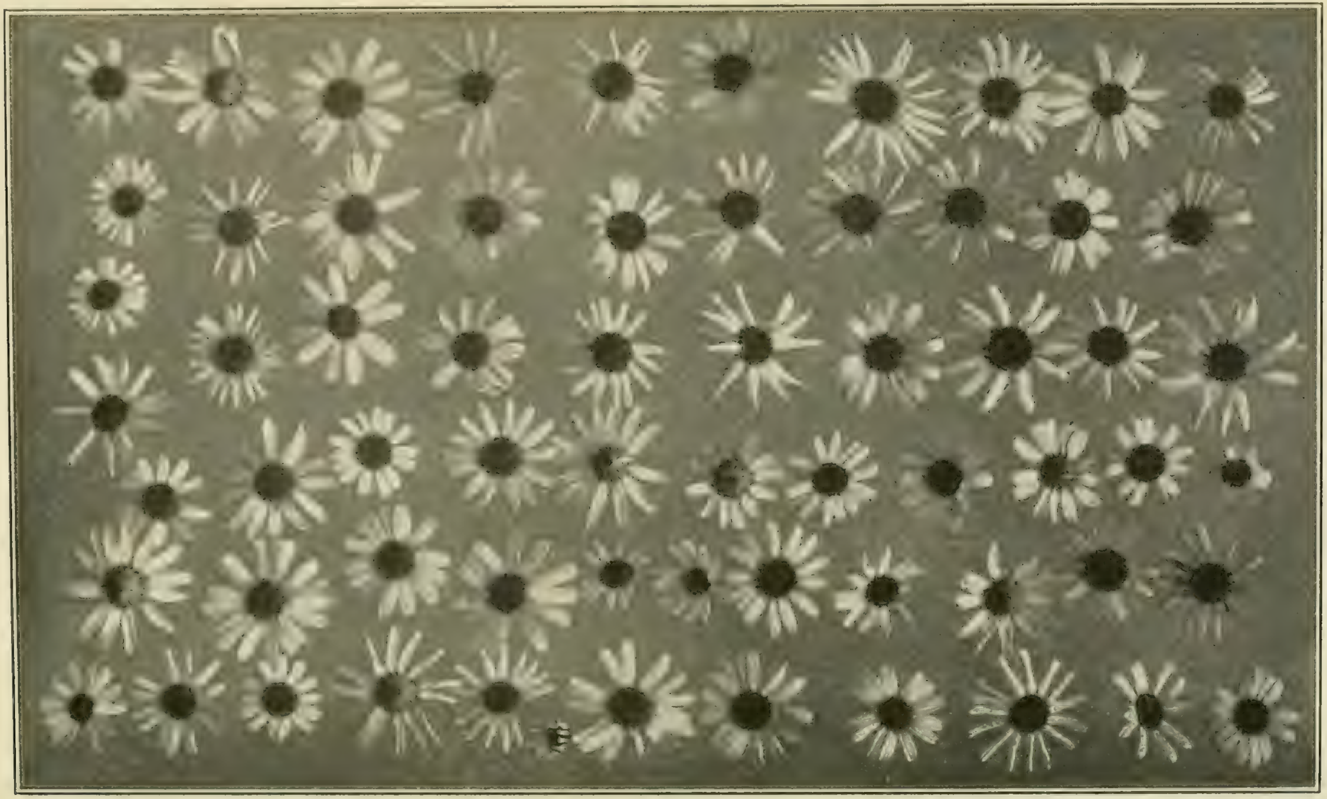

PLATE XXVII. *Common Mayweed, or Feted Camomile.* Sixty-five heads, gathered by the wayside, illustrating nearly as many forms.

but their variations in size and shape probably affect greatly the appearance of the umbels. In the first place, there is much difference observed in the color, it ranging from the ordinary white to a decided pink. As known to all observers of the carrot plant, there are pink neutral blossoms usually in the center of the inflorescence, and the stems and leaves in some specimens, especially in autumn, show this coloration to a considerable extent. It is also a matter of common observation that the young flower clusters are often of an inviting pink before the blossoms unfold, all of which has led to the saving of seed from the plants that show the pink color quite generally throughout the plant in the hope of developing a variety that may be acceptable as an ornamental plant.

The length of the stems bearing the secondary clusters varies greatly, thus making some inflorescence, open or "loose," while others are quite closed or "dense." Again, the main flower stems are sometimes so uniformly unequal as to make the whole top a hemisphere, while others are flat, and, furthermore, the secondary stems may in like manner bring the flowers to a level with each other, to form the opposite extreme in thimble-shaped clusters. The clusters of any one plant are constant.

If bred within the plant it is likely that a large number of types might be secured that would soon become fixed.

DISEASES OF PLANTS UPON HOME GROUNDS AND ELSEWHERE.

Upon the Breeding Grounds there has been comparative exemption from serious fungous diseases. The two blocks of early sweet corn, namely, "Malamo" and "Malakosby," showed some smut, the more being upon the former variety. There have been similar reports from the testers who have the Station novelties upon trial.

The tomatoes have been free from any serious trouble, the leaf blight being somewhat in evidence, and an examination did not show that any varieties were particularly infested. The so-called "yellow foliage" plants showed the "spots" most upon the leaves, but this may not indicate that they were more diseased.

It is natural, however, to suspect that the less green foliage might be more susceptible, as is true with some of the ornamental plants with variegated foliage. Leaving the tomato fruits upon the vines after ripening, as is done for purposes of study, tends to develop fruit fungi, but, as a rule, this has been surprisingly limited in amount. Lifting up the vines with metal supports, or tying them to stakes, is an advantage.

Beans the present season have not suffered materially from pod-spot, and the mildew of the limas was not troublesome. Spraying for the prevention of the latter disease has been in vogue under the general rule that delays are unwise in dealing with such enemies. Last year the crop was materially damaged throughout the state by the mildew.

Squashes have not been troubled seriously with any fungous enemies, but various insect pests have caused much damage, especially the grub in the vine varieties. Bottle gourds were much infested with an anthracnose.

Peas, for the early varieties, escaped from any disease, but the later ones became mildewed before maturing, the plants being grown for seed and not table supply. A late crop of various crosses was planted in August, after sweet corn, and the mildew was kept in check with weekly sprayings of the Bordeaux mixture.

Last year the Udo blighted so badly that only the least-affected plants were removed to a new place and the old bed was destroyed. The plants the present season, shortly after yielding a fair quantity of stems, began to show blight, and some of them failed to make much growth; the others attained four feet in height, but showed the blight in leaf and stem. Spraying was purposely omitted, but it is possible that, with occasional treatment, the plants might have been thrifty.

Among the plants in the ornamental and trial grounds the *Solanum Commersonii*, beginning in September, showed a large amount of the Late Blight (*Phytophthora infestans*) in all parts of the foliage and stems. A number of trial hills of U. S. D. A. novelties of the ordinary potatoes, growing a short distance from the above relative, showed no signs of the disease.

Asparagus Rust.

Perhaps the most destructive fungous enemy to any truck crop in recent years is the rust of the asparagus, but for the past two seasons it has been less in evidence, in part due to the introduction of more resistant varieties. Recently letters of inquiry have been sent to the leading growers of this vegetable, and from their replies it seems clear that the present season has seen a further advance toward healthful asparagus fields. One report contains the following statement: "The asparagus here is in fine condition, but little rust; in fact, some fields almost totally exempt." Another writes that: "The asparagus fields in this vicinity, although affected with rust, are not so much so as in former years, some fields that rusted last year quite badly a few weeks ago could not be detected with rust by close examination." The following report is assuring: "There is very little asparagus rust on well-cared-for and up-to-date fields, and especially is this true on those varieties grown from seed taken from plants which showed the greatest rust-resisting qualities. Until the heavy frosts a week ago my six-year-old beds were as green as the middle of July. Asparagus never looked better in this vicinity." Additional facts are given in another report as follows: "While there may be traces of rust, I have noticed none, and do not think it of sufficient importance on any beds here to cause damage, if any at all. This alludes to Palmetto. Where the old varieties are still in existence, there you see rust; even there it is not so bad as formerly."

Forest Fungi.

Two diseases among forest trees have been unusually abundant the present season. Early in the summer many complaints were made of a trouble with the foliage of the "Plane-tree," "Buttonball," or "Sycamore" (*Platanus occidentalis*). This was due to a fungus (*Gloeosporium nervisequium*) that preys upon the young shoots, often destroying them and the partially-developed leaves they bear. Early in June, in a ride from Trenton to Belvidere, it was observed that nearly every plane-tree was so badly affected as to suggest that a hard frost had visited the region. This contagious fungous disease is so prevalent as to discourage the use of this tree for any sort of planting, and, while it might be held in check by spraying, the trouble of spraying is too great to warrant the use of fungicides.

The second forest tree disease, much complained of, is a stem blight of the Chestnut, due to *Diaporthe parasitica,* recently studied by Professor W. A. Murrill, who affirms that it enters the stem, often through wounds, and spreading beneath the outer bark may girdle the tree. The infested parts bear many pimples where the spores are produced in large numbers. As the fungus works so out of reach of remedies it is recommended to remove all badly-infested trees and refrain from planting young chestnuts in localities where the disease is troublesome.

General Notes.

Among orchard troubles the pear twig blight, peach curl and apple fruit rot have been somewhat in evidence. In the fruit garden complaints have been made of the rust of the blackberry, anthracnose of raspberry, blight of strawberry and, among truck crops, the potatoes (both white and sweet) have had their rots and blights. Tomato growers in parts of the State have suffered from a leaf disease, and the cranberry growers, while still having their crop shortened by "scald" and "rot," are learning to spray against them with good results.

Rainfall of the Growing Season for Past Nineteen Years.

	1889.	*1890.*	*1891.*	*1892.*	*1893.*	*1894.*	*1895.*	*1896.*	*1897.*	*1898.*	*1899.*	*1900.*	*1901.*	*1902.*	*1903.*	*1904.*	*1905.*	*1906.*	*1907.*	*Aver- age.*
April, ...	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.43	2.88	3.64	3.78	3.49
May, ...	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	1.71	4.21	5.05	3.96
June, ...	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.43	4.48	4.41	3.70
July, ...	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	4.06	5.58	2.62	5.23
August, ...	5.18	4.90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	5.72	5.95	3.45	5.04
September, ...	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	5.23	2.19	8.08	4.14
Totals, ...	36.87	25.75	21.16	20.85	24.77	24.79	18.13	24.28	31.28	24.16	20.46	27.11	26.64	29.61	28.04	25.44	23.03	26.05	27.39	25.56
Average, ...	6.14	4.29	3.53	3.47	4.13	4.13	3.02	4.05	5.21	4.03	3.41	4.52	4.44	4.93	4.67	4.24	3.84	4.34	4.56	4.26
Rank in Wetness, ...	1	9	16	17	12	11	19	13	2	14	18	6	7	3	4	10	15	8	5	
Rank in Dryness, ...	19	11	4	3	8	9	1	7	18	6	2	14	13	17	16	10	5	12	15	

Temperature of the Growing Season for Past Nineteen Years.

	1889.	*1890.*	*1891.*	*1892.*	*1893.*	*1894.*	*1895.*	*1896.*	*1897.*	*1898.*	*1899.*	*1900.*	*1901.*	*1902.*	*1903.*	*1904.*	*1905.*	*1906.*	*1907.*	*Average.*
April,	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	46.7	49.9	51.2	45.2	49.7
May,	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	62.8	61.4	61.0	55.4	60.7
June,	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	68.3	70.4	64.7	69.2
July,	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	72.3	74.4	72.8	73.6	73.8
August,	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	71.1	74.6	70.5	72.2
September,	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	64.8	65.4	68.9	67.1	66.3
Average,	65.2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64.3	64.0	64.3	65.1	66.5	62.7	65.3
Rank in Warmth,	12	13	10	9	14	4	5	2	15	6	7	1	8	16	18	17	11	3	19	
Rank in Coldness,	8	7	10	11	6	16	15	18	5	14	13	19	12	4	2	3	9	17	1	

Sunshine of the Growing Season for the Past Nineteen Years in Percentage of Clear-Partly-Cloudy Days.

	1889. Per cent.	*1890.* Per cent.	*1891.* Per cent.	*1892.* Per cent.	*1893.* Per cent.	*1894.* Per cent.	*1895.* Per cent.	*1896.* Per cent.	*1897.* Per cent.	*1898.* Per cent.	*1899.* Per cent.	*1900.* Per cent.	*1901.* Per cent.	*1902.* Per cent.	*1903.* Per cent.	*1904.* Per cent.	*1905.* Per cent.	*1906.* Per cent.	*1907.* Per cent.	*Average.* Per cent.
April,	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	77	83	67	69.0
May,	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	74	77	68	67.0
June,	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	77	73	73	76.0
July,	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	81	81	64	75.1
August,	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	74	68	84	77.1
September,	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76	80	60	75.1
Average,	61.5	73.5	72.2	74.8	73.3	74.7	78.2	75.2	80.0	72.5	79.3	80.5	69.5	76.3	72.5	77.7	76.5	77.0	69.3	73.2
Rank in Brightness,	19	12	16	10	13	11	4	9	2	14	3	1	17	8	15	5	7	6	18	
Rank in Darkness,	1	8	4	10	7	9	16	11	18	6	17	19	3	12	5	15	13	14	2	

WEATHER NOTES OF THE GROWING SEASON.

Upon page 383 is given a table of the rainfall for New Jersey for the growing season, April to September inclusive, for the past nineteen years. From this table, made up from the monthly reports of the New Jersey Section of the United States Weather Bureau, and, therfore, based upon a large number of records made in all counties of the State, it is seen that for the current year the precipitation has been somewhat above (.30) the average. The first half of the season was wet—May unusually so—followed by a very dry July and August, which, in turn, were succeeded by a wet September, in which the amount of rainfall was nearly double the normal. While the season was not far from the average in total rain, this was so unequally distributed as to be quite unfavorable for the growing of crops.

The temperature table upon page 384 shows that the last was the coldest growing season within the past nineteen years, and, so far as this relates to crop-growing, little can be said in its favor.

Upon page 385 is a record of the sunshine, and it may be observed that its record for dark weather is only exceeded by the year 1889 at the beginning of the present series.

As a whole, the growing season for 1907 was very cold and cloudy, two meterological factors that are naturally correlated, and the rainfall was excessive for May, June and September, while the midsummer was dry and not conducive to good crops because of lack of sunshine and warmth.

REPORT

OF THE

BOTANICAL DEPARTMENT

OF THE

New Jersey Agricultural College Experiment Station

New Brunswick, N. J.

BY

BYRON D. HALSTED, Sc.D.

For the Year 1908

PATERSON, N. J:
News Printing Co., State Printers.

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REPORT OF THE BOTANIST.

Report of the Botanist.

BYRON D. HALSTED, SC.D.

EARLE J. OWEN, M.S., NAHUM D. SHORE, M.S., *Assistants.*

During the year ending November 30th, 1908, the Botanical Department has been engaged chiefly in the study of certain truck crops as sweet corn, tomatoes, eggplants, beans, squashes, peas, peppers and okra.

A different point of view has been assumed since the Department has been placed upon the Adams Fund. Instead of making the production of new and improved sorts of vegetable fruits the end, novelties become a by-product in the search for the rules that underlie the amelioration of plants. If, for example, while working out the meaning of flintiness in sweet corn and a way of avoiding it, new improved breeds are produced the people of the State may expect to profit by the specific as well as general result.

The work with sweet corn has been in the line of a better understanding of the crop through the study of crosses of diverse kinds. In the search for the origin of flintiness, that appears distressingly frequently among the various commercial varieties, crosses were first made between the "Adams," an early, starchy kind, and the long-time standard, mid-early sort, "Crosby." This has been followed by the breeding of western field varieties upon various standard sweet sorts. For the same purpose and other additional study, crosses are being extended to flint and pop varieties. The service of the branch, or so-called "sucker" in the economy of the plant is being considered, as likewise the value of water imbibition of the mature grains as a test of vitality and quality.

With tomatoes, the work has been continued along several lines, one of which is the production of a marketable-sized fruit with a long axis and a coreless, fleshy interior with few seeds. The result of the present year shows much progress and soon it may be possible to offer seeds of the desired kind. It is, however, more to the purpose of the work to find out the methods by which a fruit like the tomato may be modified and place that information in the hands of the practical growers for their use upon their own grounds. Another end sought is the production of plants bearing standard-sized, superior fruits without the glands upon stems and foliage. Such smooth plants would be highly prized by everyone who has had any experience with the disagreeable, rank-smelling, sticky exudation so objectionable with the ordinary kinds of tomato plants. A study is being made of the character units of the tomato to determine their nature, whether sympathetic or antagonistic and their behavior and value in practical breeding.

Among eggplants the work is largely with the hybrids of "American" and "Chinese" species in the hope of developing a marketable-sized fruit with a firm flesh that will neither shrivel or decay in the short period required for the destruction of the ordinary kinds. The truly spineless eggplant is striven for through crossing and selection, and as a by-product new sorts with length and reduced seediness are secured as, for example, the "Ivory" which is so named because of its color. It is a source of regret that so many of the testers were not able to get plants from the seeds of this sort sent out to them. A new supply is being secured this year from which better results may be expected.

Much time and space have been given to beans and many combinations are in hand. Here the end in view, as with tomatoes, etc., is a determination of the factors upon which species and varieties rest and the effect of each of these upon others as determined by breeding them together. The by-product may be new sorts of beans that, it is hoped, will exceed either parent. Thus, the prolific "Jackson Wonder" with its speckled thin seeds in tough pods, when bred with the "Dreer," gives a number of types of Limas, some of which by selection may become meritorious.

Squashes, while acknowledged as puzzling plants to breed, have certain features that will supplement the other kinds of crops that are under consideration. A study of the flesh, as to thickness and quality, is being made and the breeding for less seeds and smaller seed-cavity may be profitable.

The peas make an excellent crop in early season to be followed by squashes upon the same land. A study is being made of the effect upon time of maturity of the union of early and late sorts along with that of size of plant, pod, seed, etc.

Practically a full set of the commercial peppers has been grown this season for the first time and a plan is laid for an extended consideration of the various qualities of these varieties, both alone and in combination with others strikingly different in plant, foliage, flower and fruit.

In a similar manner, a plot of the commercial okras has been under consideration and crosses secured for a more extended study of the breeding habits of this species of plant.

Several crosses and hybrids among the ornamental plants have been secured that may yield points to the practical breeder in his own home garden.

During the year one bulletin, namely, No. 209, "Novelties in Vegetable Fruits," (24 pages, 4 plates, 10 figures) has been issued in which seeds were offered for distribution, which resulted in the sending to testers 2,511 packets as follows: Corn, 731; tomatoes, 807; eggplants, 332; beans, 398; squashes, 243 packets, respectively.

The necessary amount of time has been given to the details of the office desk where, aside from the large correspondence with the testers, habits of plants are outlined, names and nature of weeds given, commercial seeds examined for impurities and diseases of various sorts diagnosed.

THE EXPERIMENT AREA.

The ground devoted to plant improvement consists, as last year, of seven acres in three separate portions of the College Farm, namely, The Home Grounds that have been used by the Botanical Department for fourteen years, consisting of two acres divided into seven series of four plots each with an irregular piece of land at each end of the rectangular block of plots, all of which is shown in detail in the plan upon page 185. Each plot consists of one-twentieth of an acre marked by corner posts, thus making it easy to arrange the several crops and keep the paths in place both ways of the area, as shown by the double lines in the diagram. The irregular end blocks are occupied with grass borders and ornamental plants.

The soil is of fairly uniform quality, a mixture of clay and gravel and at the outset was not good for garden purposes but, by the annual application of twenty tons of coarse, fresh barnyard manure, it has been much improved. During the past season, the amount of manure was reduced one-half and for the first time a general fertilizer was added, at the rate of five hundred pounds per acre. These two acres occupy a gentle slope and water has been piped along the upper side to the head of each path and from outlets there placed, irrigation is made easy for the whole area.

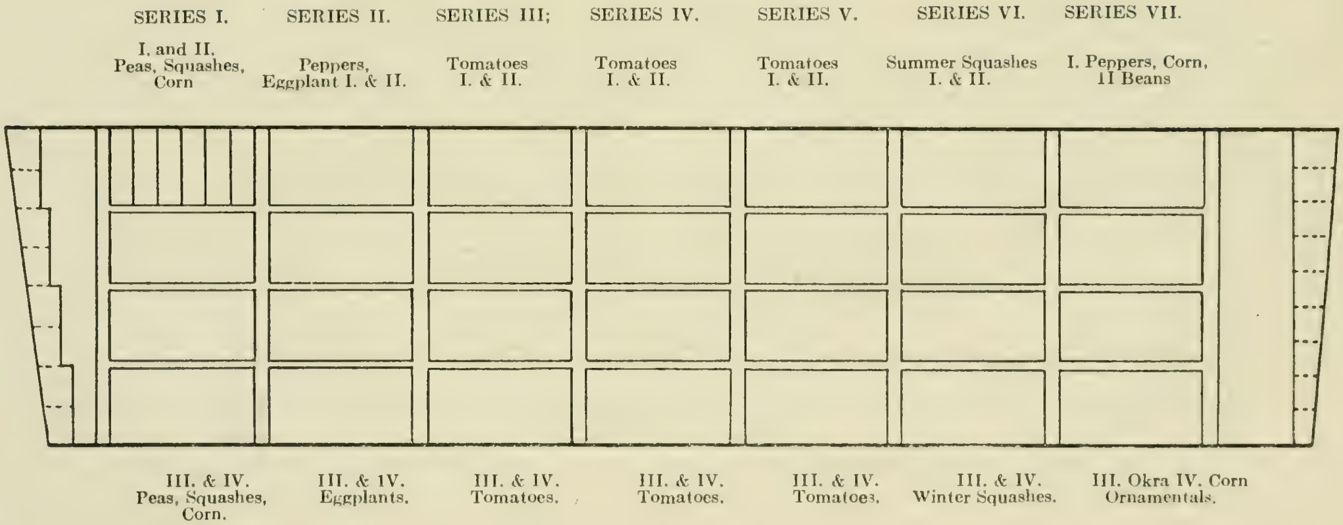
A third acre was added to the Area in 1904 and, having corn breeding particularly in mind, it consists of three equal strips widely separated from each other. This land, called for distinction "The Strips," belongs to a recent addition to the College Farm and is not brought up to the richness and tilth desired for the best results in plant improvement.

This is the second year since a third block, four acres in extent, has been in use by the Department. This land is a part of a gift of a tract to the College by Dr. J. C. Smock and is called the "Smock Land." This has made it possible to expand the field work and when the soil is built up by liberal fertilizing and winter cover crops, it will become a large adjunct in the breeding experiments.

The seven acres above described permit of the isolation of special crosses of vegetables as peas, beans, tomatoes and egg-plants. For example, by means of this adjustment, it is possible to grow not less than thirty-six blocks of corn without any serious interference by cross pollination.

In addition to this set of Station plots, fully eight hundred persons, chiefly in the State, acted the past season as testers of one or more novelties that originated upon the home grounds. In this way, the experiment grounds are extended far and wide and hundreds are preparing themselves to take up the work of breeding their own plants upon their own soil by their own hands, a result that cannot but add greatly to the interest in the growing of market produce by giving an insight into much that is now either entirely unknown or mysterious.

THE EXPERIMENT AREA FOR 1908.


SERIES I.
I. and II.
Peas, Squashes,
Corn
SERIES II.
Peppers,
Eggplant I. & II.
SERIES III;
Tomatoes
I. & II.
SERIES IV.
Tomatoes
I. & II.
SERIES V.
Tomatoes
I. & II.
SERIES VI.
Summer Squashes
I. & II.
SERIES VII.
I. Peppers, Corn,
II Beans
III. & IV.
Peas, Squashes,
Corn.
III. & IV.
Eggplants.
III. & IV.
Tomatoes.
III. & IV.
Tomatoes.
III. & IV.
Tomatoes.
III. & IV.
Winter Squashes.
III. Okra IV. Corn
Ornamentals.

EXPERIMENTS WITH SWEET CORN.

HOME GROUNDS.

Upon the Home Grounds eight blocks of sweet corn were grown and the varieties and times of planting so adjusted that the pollination between different sorts was reduced to a negligible quantity. First of all, a block of "Malamo" was planted near the middle of one half of the two acre area (shown on page 185) and upon the same date a corresponding block of "Malakosby" near the middle of the other half of the area. The "Malamo" is about a week earlier in blossoming than the "Malakosby" and, besides, the distance is sufficient for practical safety. Later on, the other six blocks were planted, the two at one end of the area with the yellow and white strains of the "Golden Bantam-Country Gentleman" cross, near the middle with the two similar strains of "Golden Bantam-Premier" cross, while the remaining end blocks were planted with yellow and white strains respectively of the "Golden Bantam-Stowell's Evergreen" cross. This plan brought blocks of the same cross nearest each other and, as a matter of fact, the white ears were practically free from any yellow grains.

"MALAMO"—("MALAKHÓV-PREMO").

The plants of this early sort were smaller than usual and the crop light, which was generally true of all the blocks of sweet corn upon all the grounds. However, the method of selection was carried out which, in brief, is as follows: A few stalks from among the best are detasseled and labeled with date, etc.; a larger number of equally good stalks are left with their tassels intact and all other stalks detasseled and not labeled (or else entirely removed). This treatment prohibits breeding within the plant (inbreeding) among one group of the best plants and secures pollination by superior plants and yields the "extra" quality seed for distribution. The second best is secured from the best stalks left with their tassels, among which there is more or less inbreeding while the least desirable product is from the inferior stalks, that were detasseled to prevent pollination by them but themselves fertilized by the best stalks.

The whole block of thirty-two hills was planted from the same ear, the latter with four of the twelve rows of grains still intact being preserved for ready reference. There is a strong tendency for the production of eight-rowed ears that it is hoped will be overcome by the continuous selection of a twelve-rowed ear for planting. It is possible that, on the whole, the eight-rowed strain is a trifle earlier but such ears are not as handsome or otherwise desirable as those with a larger number of rows of smaller, deeper grains.

This variety was not upon the regular list of novelties for the testers, but reports have come in from a few of those who have grown it. Reports from many testers were given last year filling nearly two pages of the text (pages 266-267, Report 1907).

REPORTS FROM TESTERS OF "MALAMO."

(1) "This corn is of extra good quality for so early a variety, the ears average about five inches in length and from ten to twelve-rowed. Average height of stalk four and a half to five feet. That started inside April 5th was ready to use July 4th. Planted outside in May, was ready July 20th to 25th." (2) "This year I planted thirty-five kernels and we took over three dozen ears from the row. The ears were mostly well filled. It was the earliest corn that we had and we ate the last before we pulled the first of 'Golden Bantam' which was planted the same day in parallel rows. Plants are of low stocky growth and were well set before the wet weather began."

"MALAKOSBY"—("MALAKHOV-CROSBY").

This variety occupied a block of thirty-two hills upon the Home Grounds and planted the same day as the "Malamo," was a few days later in reaching table maturity. This delay has its compensation in a larger ear; the differences in plant are greater than in the ear. The same method of selection as for "Malamo" was carried out here and, as the season was unfavorable for pollination, many of the ears were not well filled out. The planting was from seed of a single twelve-rowed ear and from the first choice of ears one was selected for the home crop for next season. . The work with these varieties is to get a uniform high-grade product. The opinions of various practical growers are given in the Report for 1907, pages 268-269.

THE "GOLDEN BANTAM-COUNTRY GENTLEMAN" CROSS (34-19).

Two plots of forty-eight hills each of the above cross were grown in Series I of the Home Grounds, the one with the yellow and the other, the white strain. The plot with the white corn was somewhat lower than the other and therefore better situated for the dry spell that brought vegetation generally to nearly a standstill and, as a consequence, the yield of the white ears was larger than the yellow, otherwise the two blocks of corn were quite similar.

The white corn was only seventy feet from the yellow strain but, nevertheless, remained practically free from cross-pollination with the latter. While it is not advocated to grow breeding corn blocks nearer than fifty yards, it is seen that a shorter distance is not especially dangerous. In this instance, the two blocks are of the same parents and any yellow grains that appear in the white ears can be easily discarded. As for the mixing in the opposite direction, it may be said that the ears are, from the nature of the case, more or less mixed with white and here again the white grains may be excluded at planting time.

This cross has proved one of the best for the present season and offers much promise of a suitable midseason variety that, possibly, may be developed along four lines, namely, the white straight-rowed and zig-zag strains and the same two grain types in the yellow color. Mature ears were harvested before the time when the "Country Gentleman" variety is ready for the table. It remains for this cross to maintain itself with the testers.

THE "GOLDEN BANTAM-PREMIER" CROSS (34-71).

The two blocks of the above cross were not well situated for the season and suffered greatly from the dry weather in June and July. The removal of a large fraction of the tassels to secure the best work in pollination may, in connection with the season, have had much to do with the lack of seed formation. Neighboring blocks of sweet corn, in which no detasseling was practiced, bore many poorly filled ears.

One block of the cross was planted with the yellow grains from a single twelve-rowed ear, while a corresponding white ear was used for seeding the other block of thirty-two hills. The tendency, noted in previous years, of this cross to produce two good ears to the stalk was in evidence but interfered with by the unfavorable season and, therefore, twins suitable for market were not usually met with.

Two hundred and nineteen packets of the white grains of this cross and one hundred and fifty-nine of the yellow grains were distributed and the following opinions are offered below:

REPORTS FROM TESTERS OF "GOLDEN BANTAM-PREMIER."

(1) "Very good corn, ears seven to eight inches long, stalks grow about five feet tall." (2) "Proved excellent, ears small but well filled out and very sweet." (3) "Plant large, ear long, thin and ridged with very sweet flavor." (4) "The corn was successful. There were two, three and four ears on one plant in many instances. The grain was very uniform but large considering the size of the ear. The plant itself was very thrifty. The leaves were large

and well developed." (5) "The corn stalk was fairly large with medium-sized ears and large grains. Very fine flavor." (6) "This is the earliest sweet corn we have had in years, large ears, fairly large stalk. I have kept some of the best for seed." (7) "This cross came out well. It is exceedingly sweet. The ears are of medium size and well filled out with regular rows of well-formed kernels, not quite as large as the yellow 'Bantam' but we think this much better as it stays tender longer. In fact, we consider this the best we have and shall certainly save seed for another year." (8) "This corn is sweet and good." (9) "Very fine quality corn with large stalk, good yield and large ear." (10) "The corn grew larger than other 'Bantam' corn. The medium-sized ears grew quickly and were of good quality." (11) "A good second-early sort." (12) "The kernels were uniformly white and of good flavor." (13) "Fine quality corn and ranks second early with us, very productive." (14) "The corn grew to a fair height with ears of fair size and grain of good quality." (15) "This corn is very early and has good-sized ears and the sweetest flavor I have known." (16) "I was very well pleased with this corn. It was very sweet-flavored, had large ears and was a good yielder." (17) "The plants grew very rapidly." (18) "Very productive with well-formed ears. Altogether an extremely satisfactory early variety." (19) "Sowed the seed April 25th, corn was ripe July 20th. Plant was six to seven feet high, two ears to a stalk which were of good thickness, small cob and large grain. Quality was good and the flavor sweet." (20) "The sweet corn grew finely." (21) "Corn was very early and very good. The plant was dwarf with medium-sized ears, large and sweet grain and very productive." (22) "This corn was one of the best for quality of grain." (23) "The ears were well filled out." (24) "The plant is strong and a good bearer with nice ears and good eating quality. A valuable acquisition." (25) "The stalk was not very large, ears were medium size with a large and sweet grain." (26) "The ears were of good size, mostly ten-rowed." (27) "There were two ears to almost all the stalks. Plant strong and healthy, flavor sweet and good." (28) "This corn is an exception to any sweet corn I have had for flavor and it yields well." (29) "The plant was thrifty and very tall with beautiful ears." (30) "The seed came up well and gave fair-sized and well-developed ears. Corn was very sweet; we liked it very much." (31) "We enjoyed this corn, it was sweet and juicy. Ears were of fair size and every grain white." (32) "The stalks of this corn were not tall but leafy. Ears were of fair size and with short, small cob, deep grain and some had eighteen rows." (33) "Stalks and ears were of good size, yield good and quality excellent." (34) "This corn had a vigorous stalk, broad leaf and fair-sized ears. Ears very solid, tender and sweet." (35) "Corn was of medium height, small ear, very sweet and delicious." (36) "This did the best of any corn planted, although the conditions were about the same for all. The plants were vigorous, the corn sweet and juicy and altogether a satisfactory variety for my next year's planting. The grains were full and developed to end of ears." (37) "This cross grew very well with us, the stalks were about five feet tall and they yielded each two nice ears of corn. A good kind for market or home use." (38) "The corn has a very nice flavor and is small." (39) "This is a fine sweet corn with medium-sized stalks, nice sized ears. Very tender and sweet." (40) "This corn grew about five feet high. The ears were from eight to ten inches long and of a good quality." (41) "The corn grew well for the season with well-filled ears." (42) "I found that 95 per cent. germinated which was, in my opinion, an unusually successful planting. The size was normal, better than some sweet corn we have planted. The plant was strong and had an average of two and a half ears to a stalk. I was more successful than my neighbors with other corns." (43) "Planted May 19th, cut July 29th. Stalks were four and a half to five feet. Ears were of fair size with eight to twelve rows, quality excellent, tender and sweet." (44) "The size of the plant was medium. The ear was large and the grain small. The yield was good." (45) "The plant was about six feet high, short, chunky ear, well filled with large grains which were quite juicy and sweet." (46) "The stalks were five to six and a half feet tall, the ears averaging seven inches long and a large majority have two ears to a stalk. Quality good." (47) "I consider this corn of very excellent quality. Ears about ten inches long with small cob. The large grains are of delicious flavor with twelve rows to the ear." (48) "The corn was very nice with good-sized ears." (49) "The sweet corn was fine, the seed came up well, had very nice big ears which were very sweet. I was very much pleased with it." (50) "This corn was very sweet." (51) "The corn was very nice and the ears were from six to eight inches and the stalk from four to four and a half feet and the grains very large." (52) "The quality of grain was good." (53) "This corn grew to about five feet with two or three and some four ears on a stalk; the ears were about eight inches long, well filled with large white grains." (54) "The corn was very sweet and had small, short ears." (55) "This corn is early, grows about five feet high with very good-sized, eight-rowed ears." (56) "The plants are of good size, ears of fine shape, eight-rowed and well filled; grains were of an excellent flavor." (57) "The corn was of excellent quality and flavor, ears not very long but very deep grains and quite productive." (58) "The corn has fine ears of medium size and very sweet. I am well pleased." (59) "The quality of grain is good." (60) "The stalk is short, ears are eight or ten inches long and good sized grain." (61) "Permit me to say the 'Golden Bantam Premier' cross was the finest and most beautiful corn that ever went on any man's table. Grains were plump and very tender, ears were from seven to nine inches long." (62) "Stalks were from five to six feet high, one ear to a stalk." (63) "The stalks measured between six and eight feet high. Three and four ears to a stalk and twelve rows of grains on ears and very plump." (64) "I find these ears are eight-rowed, stalk about six feet high. I had corn tested by a number of people and all pronounced it excellent." (65) "This is the best corn I ever had, stalks were six feet high, ears eight inches long, fine quality and grains uniform and sweet. Ears filled out to the full length of cob, strong plant and corn on every stalk. I have had three other kinds but this is by far the best corn I ever grew; it is good now, Sept. 22d." (66) "Corn planted May 16th, had it on the table August 9th. Had some ears eight inches long and eight-rowed. I do not think any corn could be sweeter. Some stalks were about seven feet tall. There was only one fault, there was not enough of it." (67) "The corn which I received from you was excellent, ears about ten inches long and the grains large. The stalks are very high, the ears are very full." (68) "The corn grew five feet high, small but full ears, the quality is fine." (69) "I was especially pleased with the corn. It was of fine flavor and had large ears." (70) "The corn I think must be an excellent variety as I had corn about the middle of July and was not expecting any at all as it had not rained for almost six weeks. The corn was good and the ears well filled." (71) "The corn was fine, tender and sweet, ripened earlier than 'Golden Bantam,' which was planted two weeks earlier." (72) "A good-sized medium and generally uniform variety. Quality excellent, exceedingly tender and delicious, remaining so longer than most sweet corn." (73) "The plant has a fine stalk five and a half feet high. The ears are set low and eight-rowed. The grains are broad and flat and very sweet." (74) "The corn is first-class in every particular, extra fine flavor; nice grain and strong grower." (75) "The corn was planted late in June, about the 15th, and I had corn for the table the last week in August. The stalk grows rather slender and about seven feet high, bearing about 30 per cent. with two ears to the stalk. Ears are from six to eight inches long and about 50 per cent. are eight-rowed while the balance were ten-rowed. The ears had broad, deep grains which were very tender and sweet. I do not think I ever tasted such sweet corn. The ten-rowed ears were much superior." (76) "The corn was very sweet, much sweeter than any other varieties that I had planted. The stalk and ears were small but extra early." (77) "This was a rapid grower, ripening at least two weeks ahead of 'Country Gentleman' planted at same time. Stalks were short, ears small, grains in straight rows, cob small and grains very wide and deep and exceedingly sweet, superior flavored. We consider it a good sweet corn and shall replant next year." (78) "The stalks were of uniform size and vigorous healthy growth. Medium-sized ears." (79) "Your sweet corn was of fine size and the best, I think, I ever ate; it was fine and I was well pleased with it." (80) "Quality of this corn was good." (81) "This corn was very nice, grains of good size with small ear but well filled out and of a delicious flavor." (82) "The ears were ripe in sixty days, plant about five feet in height, the stalks having a great many suckers which grow almost as high as main stalk and bear ears; each stalks yields two to three good ears, small but perfect, eight-rowed and very sweet." (83) "I planted this corn on the best ground I have and it did well. Stalks were big, some eight feet tall, ears being big and solid." (84) "In spite of the very dry weather, this variety was very productive. The stalk was of average height; a good-sized ear of uniform grain. I am well pleased throughout." (85) "This corn is medium-early. Quality is very fine." (86) "I planted the corn along side of the 'Early Minnesota' and the corn that you sent me yielded eighteen ears more to the hundred hills than the 'Early Minnesota, and I also considered it a sweeter corn and it grew larger stalks." (87) "The plant was more than five feet in height, vigorous in growth with two well-developed ears to the stalk. Ears were about six inches long, perfect in growth and filled out to the end of cob. Grain of good size." (88) "Stalk medium in height and of vigorous growth. The ears are of good size; the quality is of the best and I say truthfully it is the sweetest corn of which I know. Many stalks have two ears on them." (89) "Good-sized ears, eight to twelve-rowed. Plant medium early. An excellent variety." (90) "We rated it a very delicious sort of sweet corn. A quick grower and bountiful producer. Perhaps the grains might be a little fatter or deeper, but it is a good table corn." (91) "This corn had stalks from seven to ten feet high, the ears being from seven to nine inches long, very close-grained and most of them eight-rowed. Quality is excellent; I have never tasted a sweeter corn." (92) "The corn was most satisfactory being very sweet with full ear." (93) "The stalk grew about four feet high and the ears were filled out. The corn was very tender and very nice." (94) "The ears were short but full." (95) "The stalks were five feet high, with medium-sized ears of good quality." (96) "This is an early variety, growing from five to six feet high with eight-rowed ears; medium size." (97) "The corn was very sweet and of excellent flavor." (98) "The quality is fine, just as good as 'Golden Bantam,' almost as quick a grower and a much better yielder. Shall use it for first early hereafter. (99) "This corn proved very productive." (100) "The corn was very nice and sweet, the stalks about five feet high and size of ear about ten inches." (101) "The stalk is tall with two ears apiece; the grain is very sweet." (102) "I have never had any sweet corn to equal this. I consider it the best of all corn I have ever raised. The ears were about ten inches long and large grains of fine flavor. The stalks grew about six feet, eight inches high." (103) "This was very good. I planted it early and it overcame the dry weather; would recommend it." (104) "This variety had small ears which were very sweet. There were three ears to each stalk." (105) "The stalk grew five and a half feet high, ear of fair size with large white grain of good eating quality." (106) "This cross is one of the best. It has rich, dark green foliage; the plant is very hardy and almost every stalk has two ears. It is of good flavor and I think so much of it that I intend to plant a great deal of it next season." (107) "Stalks and ears of medium size, grains of good quality and from one to two ears per stalk." (108) "The corn was excellent and very productive." (109) "The corn was very fine with large ear and deep grains."

THE "GOLDEN BANTAM-STOWELL'S EVERGREEN" CROSS (34-83).

Yellow grains from twin ears were planted in thirty-two hills making one of the two blocks of this cross grow upon the Home Grounds, while white grains from solid white twin ears were used for the second block. Both strains were far below the high grade of plants and product of the year before upon the same ground. Many ears were imperfectly filled out, making it difficult to find a set of ears suitable for a photograph and an engraving.

It seems demonstrated that the combination here made has resulted in a cross that is earlier than the "Stowell" with much of its length and richness of grain.

One hundred and six packets of the white grains of this cross and ninety-three of the yellow grains were distributed and the following replies will give the reader the views held by various practical growers.

REPORTS FROM TESTERS OF THE "GOLDEN BANTAM-STOWELL'S EVERGREEN."

(1) "This variety is early with good-sized ears. The yield is good and the corn very sweet." (2) "The ears are very large, well filled out and are of a delicious flavor." (3) "The flavor is very good and very sweet." (4) "I am perfectly satisfied with the corn; the ears, three on a stalk, were long and well filled with small close grains; the finest corn I ever ate." (5) "The corn has nice-sized ears with large grains." (6) "The corn has a fine growth and ears of good length; the grains are uniform and the corn is sweet and tender." (7) "The long ears have large stout, white grains and short stalk. Very good quality." (8) "This corn is fine; grains are extremely sweet." (9) "A good corn for the home garden." (10) "It is a very good kind of corn, being the only kind we had that amounted to anything this season. It is not very large with long ears and medium deep grains." (11) "Had fair-sized ears, two on most stalks, and well filled out." (12) "The corn came up well, started off nicely and made a quick growth." (13) "The ears were of nice size, very white and sweet." (14) "The plant was of medium size with large ear of fine quality." (15) "The ears are large, stalks medium and ears set close to the ground." (16) "The corn stalks grew to about six feet, ears were about six inches long and corn was of good quality and flavor for eating." (17) "This corn was the best I ever had on my table. Every member of my family praised it. Ears were of good size and well filled. I have saved a number for seed." (18) "Ears were of good size, good quality and quite productive." (19) "The seed came up finely, it grew quickly. The ear was short with good-sized grains, which were very sweet. The height of the corn was about four feet." (20) "The corn was fine, the ears were medium-sized and the grains were deep." (21) "This corn was very early with well-filled out ears of a sweet flavor." (22) "The corn grew about five feet high, had fair-sized ears. The grain was sweet and deep-set in the cob." (23) "The corn is all right, very fine. Flavor excellent." (24) "The plant was about seven feet tall. The quality is considered excellent and the grain continues long in edible condition." (25) "A midseason variety growing seven feet high with large, twelve-rowed ears." (26) "The corn was fine." (27) "The size of plant was about four feet, medium-sized ear

and quality of grain was very sweet." (28) "This corn was the finest I have ever raised, the plant was six feet tall with three ears on most plants. The ear was good size with large white grains and very well filled out. Flavor very good." (29) "The corn was very sweet-flavored." (30) "The plant was very vigorous and thrifty and a rapid grower, securing an early start. The grain was very regular." (31) "The corn grew finely, the stalks being over six feet tall. The kernel was quite regular in shape. A very sweet variety." (32) "This variety was larger in girth and taller than most kinds of sugar corn; grain was large and firm. The plant was very prolific. I pronounce it a fine variety of corn and have saved seed." (33) "This corn was of excellent quality, tender and sweet." (34) "This corn is a vigorous grower, every stalk having an ear on it. Ear was small but well filled with grains to the end." (35) "The corn was good. I think it is a fine variety." (36) "Each stalk produces one full-sized ear of corn, well filled with deep grains of fine flavor and very sweet. I am very much pleased with this corn." (37) "I planted the corn in my garden and of the different kinds I had I think the 'Golden Bantam-Stowell's Evergreen' was the best, sweetest and most tender." (38) "I had a very good crop, uniform in size, ears from six to eight inches long." (39) "The corn was all you claimed for it, the stalks were strong and of good height and quite productive. The ears were of medium size and very sweet." (40) "The ears were large and the quality of the grain was fine." (41) "The ears were of large size, uniform in shape and had good large grains. The quality of the grain is very sweet." (42) "This made a good stalk for a sweet corn." (43) "For table use it is surely fine." (44) "The corn was excellent, of good size, very sweet, uniform and productive." (45) "The stalks were about seven to eight feet high, the ear nice and round and about ten to twelve inches long, grain very sweet. I think for my taste it is about as fine as I ever ate." (46) "The corn did fine and was very early. The ears were of good size, deep grains and very sweet and fine taste." (47) "This is an early sort with good-sized, twelve-rowed ears and stalks that grew six to seven feet in height." (48) "The corn grew about five feet high; the ears were set low down and were of good size and fine flavor." (49) "The plant was five feet high and of vigorous growth. Ear was of medium size, one to a stalk. Quality extremely sweet and uniformly good." (50) "Stalks were seven to eight feet high and the ears were six to seven inches long. Quality excellent, nearly equal to pure 'Bantam' with advantage of having large ear." (51) "I will say that the corn was fine, the stalks were medium-sized and the largest ear was eight inches long. Altogether, I am very much pleased with this variety as it is sweet and grows to a good size." (52) "The plant was vigorous and of good shape. Some of the ears were one foot long and some smaller. The quality of the grain is all right." (53) "The corn was fine. We were fortunate and planted it on low moist ground and it grew fine and quickly. We were very much pleased with it." (54) "The corn came up well and made a strong growth to about five feet high, the ears were well formed and there were two or more on most of the stalks, which were well filled out to the end of cob. It has an extra fine flavor."

CORN UPON THE STRIP LAND.

The three "Strips," three hundred feet long and forty-five feet wide, bore each three blocks of corn, namely, (1) at the east end, (2) the middle and (3) the west end, respectively. Each block consisted of six rows of fifteen hills each, or a total of ninety hills. Each block had two halves of three rows each and the western half was planted with an early maturing sort, while the eastern half had a slower growing cross. All planting was done on May 12th.

In the order of their development, the western half (forty-five hills) of each block deserves first attention here. Following a wet and, therefore, late May, unfavorable for sweet corn, was a dry June, the drought of which lasted beyond the middle of July. Under such conditions and upon a naturally dry soil, the crop was very poor.

Three of the nine half blocks were occupied with a test of the "Malamo," namely, the color of the grain and flintiness.

"MALAMO"—"WHITE" GRAINS.

The forty-five hills were planted with grains from a single white (straw-colored) ear. Upon August 29th, the poor crop was gathered and of the thirty-eight ears only two showed the pinkish or amber grains. This difference in the shade of the kernel is an ear-character that is present in the "Malamo" and its parent, the "Malakhov."

"MALAMO"—"PINKISH" GRAINS.

The half area of Block 2 was planted with the grains from a single "pinkish" ear and of the fifty-four ears gathered thirty were strongly "pinkish."

A TEST IN SELECTING FLINTY SEED CONTINUED.

As stated last year, several kinds of sweet corn have a strong tendency to produce starch in place of sugar and such grains, when mature, dry smooth or nearly so instead of being wrinkled as is characteristic of the best sweet kernels.

Last year a block of "Malamo" was grown from grains showing flintiness selected from among ears that showed all degrees of the condition in question. At the same time, a similar plot of sixty hills was grown from the sweet or wrinkled grains of the same ears. The results of these two plots were shown in a plate in which it was easy to note that there was a marked reproduction in the ear of the quality of the seed from which it grew. In other words, the ears from the block planted with flinty grains were largely flinty while the sweet grains gave ears that showed, as a rule, very little tendency to produce starch.

From three of the flinty ears of last year's crop, grains were selected for the continuation of the test. The season was exceedingly poor for early corns of the "Malamo" type but such ears as were matured showed without exception a large degree of flintiness. In order that the individual grains may be better

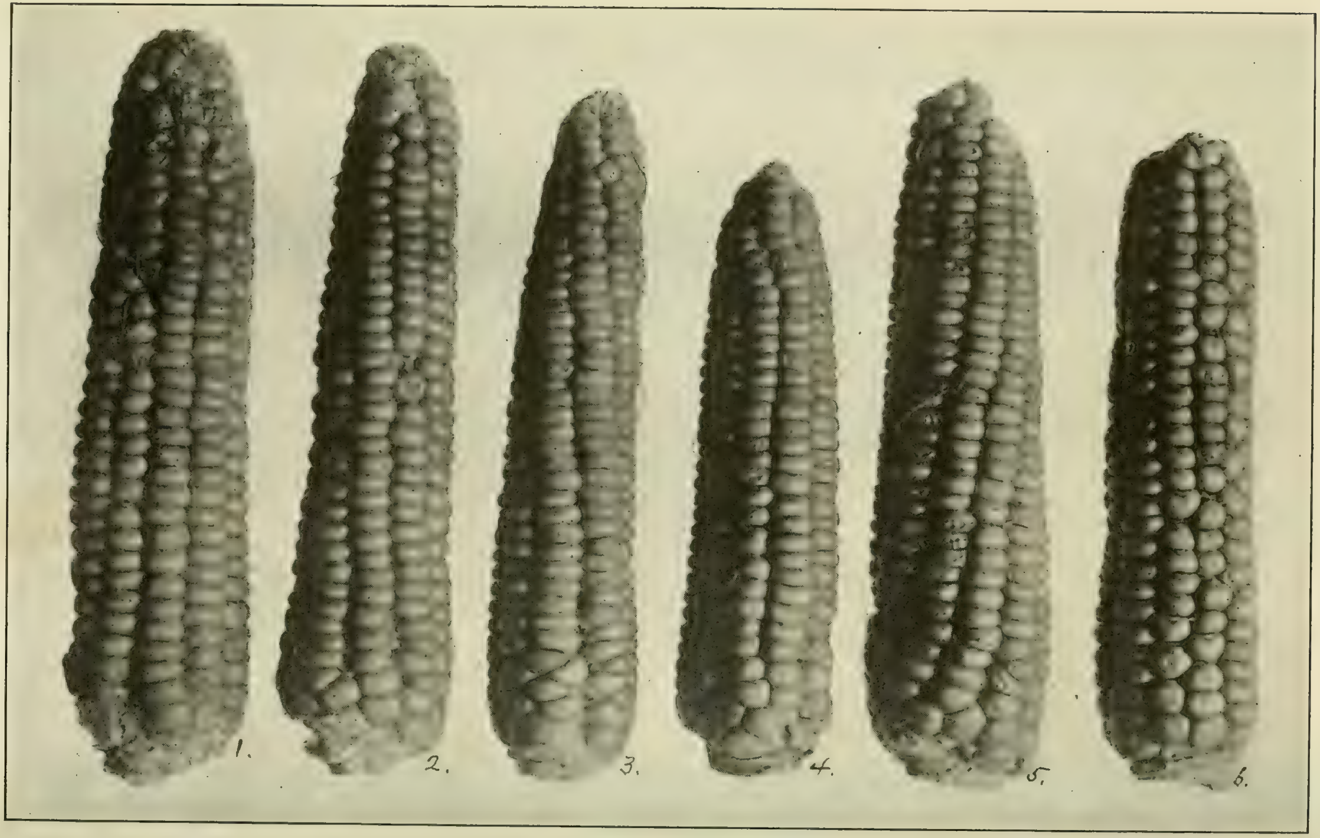


PLATE I. *Flintiness in Sweet Corn.* Six ears from a block of "Malamo" sweet corn are shown, resulting from two successive years of selecting flinty grains for planting. The sugar-producing tendency is largely lacking as shown by the smooth, starchy grains.

shown, the number of ears (Plate* I) is limited to six and the ears with sweet grains from the check plot are omitted in this instance. It will be easy to observe that the number of grains that show any wrinkling is quite limited and a kernel of the normal sweet corn is not to be found.

In the neighboring plot, planted with sweet "Malamo," the ears were of the ordinary sort. This control plot does not permit the opinion that the conditions under which this crop was grown are to be charged with the development of the flintiness in question. The tendency to produce starch is neither an ear characteristic, as color of the cob, nor a grain character like the color of the grain but takes an intermediate place between them. It remains to be seen whether the acquired flintiness is a character of the same power over sweet sorts as that of long standing in true flint varieties.

"MALAKOSBY"—"WHITE" GRAINS.

From a single white ear, grains were selected for planting the half of Block 4. In this instance all of the ears in the small crop were true to the color of the parent grains.

"MALAKOSBY"—"PINKISH" GRAINS.

A single ear here, as elsewhere in this experiment, furnished all the seed grains and the inferior crop of twenty-two ears were equally divided between those that were "pinkish" and those that were "white."

"MALAKHOV"—"HUSKY" GRAINS.

Only a few of the grains of a small ear furnished by Dr. W. W. Tracy, United States Department of Agriculture, sprouted and none of the plants reached much size. The grains that were secured were largely of the mother sort and showed the loosening of the outer wall that gives the appearance and feel of a dry extra cover to the grain.

"GOLDEN BANTAM-BANANA" CROSS (34-6).

This half block was very early and small and the crop inferior in all respects. In shape of ear and zigzag arrangement of grains, it represented the characteristics of the cross.

Thirty-seven packets of the white grains and twenty-six of the yellow grains of this cross were distributed and the following reports have been received:

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*The plates in this Report are made from photographs taken by Mr. F. H. Dodge, to whom many thanks are due for his painstaking skill.

REPORTS FROM TESTERS OF "GOLDEN BANTAM-BANANA."

(1) "This corn was very prolific, of vigorous growth and with two or three ears to a stalk." (2) "Large stalks and good yield; excellent quality." (3) "The stalks were five feet; the ears were slender, being five to six inches; the grain was very good." (4) "It was splendid eating corn." (5) "This corn was very productive with two and three ears to a stalk. It was early and grew about six feet tall." (6) "The ears were of good size and stayed in good eatable condition for a week or more." (7) "This variety was early with medium-sized ears, growing six to seven feet high." (8) "The corn was very nice." (9) "The corn proved to be a vigorous grower and was very prolific." (10) "Planted May 10th, we had the first to eat July 30th and it was sweet and tender. The stalks were from six to eight feet high, very vigorous and mostly two ears to a stalk and were four to eight inches long. There were twelve to fourteen rows of grains to each ear." (11) "Have had success with this corn and must say it is the sweetest corn I have had yet. It bore good-sized ears and those evenly grained. Plants are of medium size, five to six feet high." (12) "The corn was not very large in size but was very sweet and had a good-sized grain." (13) "I found that the corn was very sweet, very early, very productive, sometimes one stalk having three ears, and an early market variety." (14) "This corn had large stalks. It was of fine quality and I prefer it to any other." (15) "This corn was a strong, vigorous grower. The quality was excellent. Each stalk had one fair-sized ear, some had two." (16) "This corn was very sweet." (17) "This variety was prolific with a well-shaped ear which was very sweet."

"GOLDEN BANTAM-COUNTRY GENTLEMAN" CROSS (34-19).

White grains of a zigzag ear were used for seed and the poor crop showed seven fully zigzag ears and seventeen that were partially so.

"ADAMS-CROSBY" CROSS (2-20).

The seed for this half block (No. 9) was selected from a single sixteen-rowed ear. Of the forty ears gathered, only four were eight-rowed, the others being mostly twelve-rowed and of the shape as shown in the plate of this cross in previous reports. This is a desirable cross when conditions favor the production of early corns.

Sixty-seven packets of this cross were sent to testers the past season and below will be found the various remarks concerning this combination.

REPORTS FROM TESTERS OF "ADAMS-CROSBY."

(1) "The ears and grains were of good size and the growth was very rapid. The quality was very sweet and the ears were well filled with plump kernels." (2) "This is an eight-rowed corn, ears eight to ten inches long and stalks five to six feet tall. The grains are set close together. I think it is a fine corn." (3) "There were two ears to a stalk and they were five to six inches long." (4) "This corn had very high and thick stalks with long ear and fine, even grain which was tender and sweet. It produced two ears

to the stalk." (5) "The ear was small to medium, quality good for early corn, and plant was productive." (6) "This variety yields well with short, large-grained, well-filled ears. It is a sweet corn of excellent quality." (7) "The size of plant was about five feet and the ear was perfect. The quality of the grain was small and very sweet." (8) "The ears were well filled and had straight rows of corn. The quality of corn was excellent." (9) "The height of stalk was seven feet; the ears, which were well-filled, were seven inches long. The corn was very sweet and of good quality." (10) "The ears were short but were filled out with good-sized grains of fine flavor." (10) "The corn turned out very fine. The stalks measured eight feet, four inches." (11) "I planted the corn and it was fine. It had a very nice ear and a good-sized grain and was very sweet." (12) "Stalks were of good size and so were the ears. Large grains." (13) "Good quality of grain." (14) "It had a nice ear and fine quality. A very good table corn with not a very large stalk." (15) "The plant was large and vigorous with large and abundant ears, perfect in shape and filled well out to tip. The eating quality was fine. The germinating power was 100 per cent. The corn was very satisfactory and by comparison with other early corn, planted at same time and under similar conditions, was very superior."

"IOWA SILVER MINE-STOWELL'S EVERGREEN" CROSS (144-93).

This block of forty-five hills was planted May 12th and, in spite of the poor soil and very dry June and the first half of July, made a growth that was altogether satisfactory for sweet corn. Some of the ears were mature and gathered for seed in early September.

A word as to the history of this cross is opportune because of quite an unusual kind in the breeding of sweet corn. In 1906, the "Iowa Silver Mine" was planted as a breeder among a list of the standard varieties of sweet corn. This favorite kind of field dent corn was procured from a grower of pedigree seed corn in Iowa and even upon poor soil it showed its great vigor by growing to almost twice the height of the sweet sorts that surrounded it. Owing to its being much slower in coming into flower, crosses were secured only between a few sorts, usually of the later group. As the grains of the "Iowa Silver Mine" are strongly starch-bearing, the mixing of this variety at once marked itself upon the sweet sorts by the crossed grains following the male parent in the starch-producing quality. Such dent grains standing among the sweet wrinkled grains of the otherwise sweet ears, were selected for planting last year (1907) when a crop was secured, in which many of the grains (probably one-quarter) were sweet and wrinkled when mature. It was from these sweet grains that the planting was made the present season.

There were ample means of comparing the growth of the "Iowa Silver Mine-Stowell" cross plants with both sweet and field corns that were grown upon the same general area and it is clear that the union has resulted in an increase of vitality as shown by the ability of the plants to obtain moisture during a prolonged drought and make a growth of stalk, leaf and ear that far exceeded that of the ordinary sweet kinds grown under the same unfavorable circumstances.

There was considerable variation in size of stalk and time of reaching maturity and, therefore, by using the method of detasseling and labeling, the earlier and otherwise most desirable plants were selected for future improvement of the cross. The tendency to produce twins was quite evident and, as the stalks are large enough to bear them, these twin ears have been saved in the hope of making two-eared stalks the rule with this type of corn.

The ears themselves, as might be expected, are of large diameter for their length which is true of the "Stowell," and the "Silver Mine" is not unlike it. Both parents have long kernels and the cross is remarkable for smallness of cob and a corresponding depth of grain. A test of the quality showed that the hope of a high-grade corn is realized.

As previously stated, one of the practical points sought in this cross was an added vigor to the whole plant and it is evident that this is secured without sacrifice of quality. As it now stands, the ear is handsome and the grain long and rich but it remains to be shown that, by breeding with early sorts, this hardy type of plant can be combined with further speed in bringing the crop to table maturity.

In the upper half of Plate II, five ears are shown, the two united by their husks being from the same plant and not quite as mature as the others. There would have been much greater uniformity in appearance if the photograph had been taken when the grains were all equally dried.

"IOWA SILVER MINE-COUNTRY GENTLEMAN" CROSS (144-19).

There were two blocks of this cross, each consisting of forty-five hills, one planted with grains from a zigzag ear that showed a beautiful pink tint upon each kernel, the other with grains from two white zigzag ears—the importance of this cross warranting the greater space that was given to it. The method of securing this combination is the same as that given for the preceding cross.

Here the plants showed the vigor that, under the circumstances of a poor soil and a dry season, makes all the difference between a good crop and a failure. Alongside of both the blocks in question, an equal number of hills of an early sort were grown and the contrast between the two was great in the extreme.

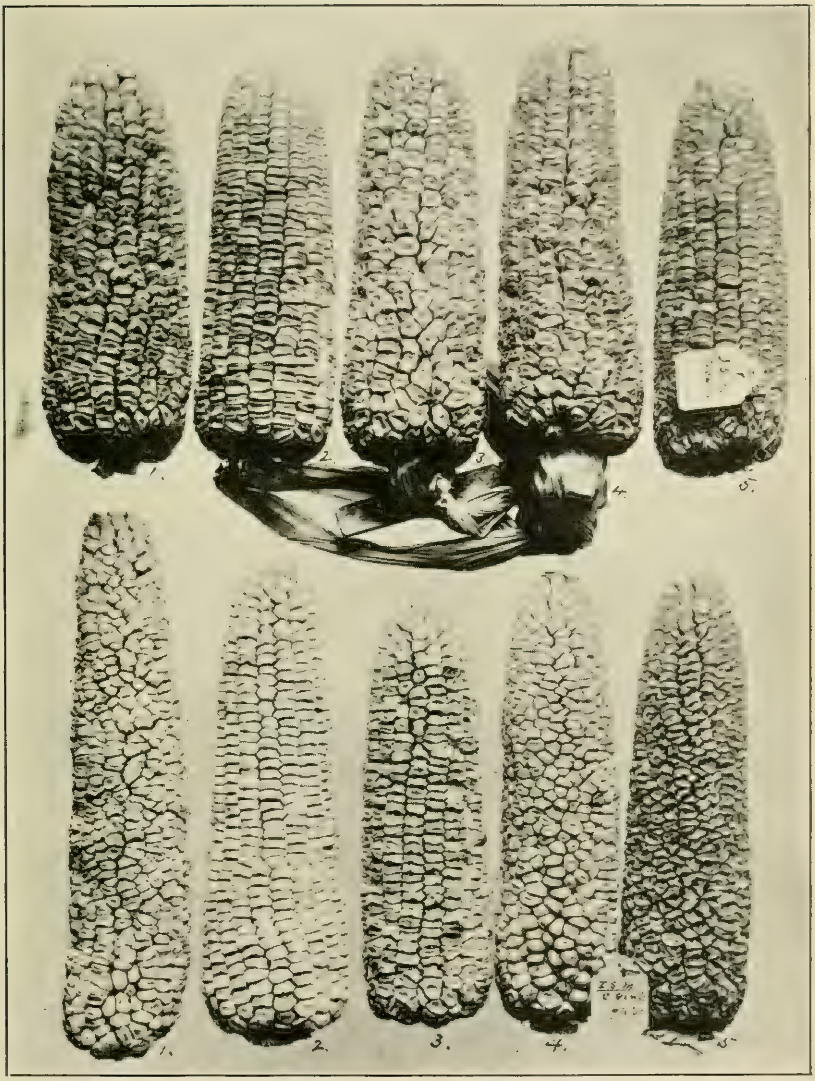

PLATE II. *Crosses of Field upon Sweet Corns.* In the upper half are five ears of "Iowa Silver Mine" upon "Stowell's Evergreen," the two with husks being twins. The lower half shows sample ears of the "Silver Mine" upon "Country Gentleman," the right hand ear being the only one fully dried at the time the photograph was taken.

While the season was unfortunate for the production of sweet corn of the ordinary kinds, it was very favorable as a test of the ability of the cross to make a crop under bad conditions that may not be exceeded for many years to come. The stalks were tall and stout and the ears of fine large size, possibly too large to suit many, but by selecting from the twin ears for future planting there is hope of securing a prolific strain that will be in every way desirable.

The number of straight-rowed ears exceeded those with zigzag arrangement of grains. There were many ears that were intermediate in the disposition of the kernels upon the cob. The male parent, "Iowa Silver Mine,' has a "rusty" cob while that of the "Country Gentleman" is white. A count of the ears in this regard showed that, among those selected for seed-saving, there were three times as many "rusty" as white cobs. The opportunity to study this same character in the other seven crosses of "rusty" with white-cobbed sorts brings a result that leads to the general opinion that the "rusty" cob is an ear unum that is dominant over the white in the same way that a dark grain is dominant over a white grain as has been repeatedly shown in previous reports. On account of the cross involving the cob character in question, it is possible to develop two strains as regards this unum. It may be an open question which is preferred so long as the color, when table mature, is only slightly in evidence.

When the arrangement of the grains is considered along with the cob color, it is seen that at least four strains, possibly, may be derived from the cross, namely, (1) straight-rowed "rusty" cob, (2) straight-rowed white cob, (3) zigzag "rusty" cob and (4) zigzag white cob. The last named will be the most like the mother parent and this derived strain may have at least two qualities somewhat modified, namely, an added earliness—a point to be demonstrated—and a larger ear when grown singly but of desired size when the tendency to produce twins is fully developed.

The lower half of Plate II shows five ears from the block planted with pinkish grains—a tint that did not appear in but a few ears. It is to be noted that the zigzag arrangement of the grains is evident in three of the ears. In the upper half of Plate III are shown five other ears from the second block of the same cross. The two with husks are twins and remarkably stout and short, as well as with the grains zigzag. At the right, is an ear that approaches the ideal in shape and depth of grain but, perhaps, too large for the more fashionable lovers of this vegetable.

"PRIDE OF NISHUA-STOWELL'S EVERGREEN" CROSS (145-93).

The above cross was effected in the same way as that described for the crosses with "Iowa Silver Mine." The "Pride" is a yellow dent sort of high repute in the vast cornfields in the West and the original stock for planting was from an ear procured from a seed-corn breeder in Iowa. In the size of plant, general habits of growth and value of product, it differs but little from the "Silver Mine" excepting in the color of the grain which is yellow instead of white as is the latter.

Little can be added to what has been said above of the "Silver Mine-Stowell" cross, as the plants are equally strong-growing and fruitful. Perhaps here there was a stronger tendency to productiveness than elsewhere among the crosses for pairs of twins were not uncommon and some stalks bore three ears, all of acceptable thickness and with but little left to be desired in length. The grains are deep and the cob correspondingly small, giving a large percentage of the edible portion. All tests as to the quality proved satisfactory.

The lower half of Plate III shows five ears of this cross, the two at the right being twins and of a desirable size and shape. At the center, bearing the label, is an ear that is quite like the field parent in general outline but the grains are sweet. A plot of field corn near by has marked some of the grains as shown in the ear at the extreme left.

Out of this cross (of course all straight-rowed ears) can come the following strains: (1) "rusty" cob with yellow grains, (2) "rusty" cob with white grains, (3) white cob, yellow grains and (4) white cob, white grains. This last will the most nearly resemble the "Stowell" parent but the blending of the various qualities of the plants of the two widely-separated varieties will result in a new kind of corn.

"PRIDE-STOWELL" CROSS (YELLOW).

On account of there being two colors involved, there were two blocks assigned to this cross, the one (4) planted with white grains and the other (5) with yellow kernels. There was no material difference between the plants of the two blocks or in the number, size and shape of the ears. There was a tendency shown for the rows of grains to lose their directness and become somewhat of the zigzag type as shown by the pair of twins to the left (Plate IV) while the twins at the right are of the true parental type. An ear that was remarkable for its earliness and

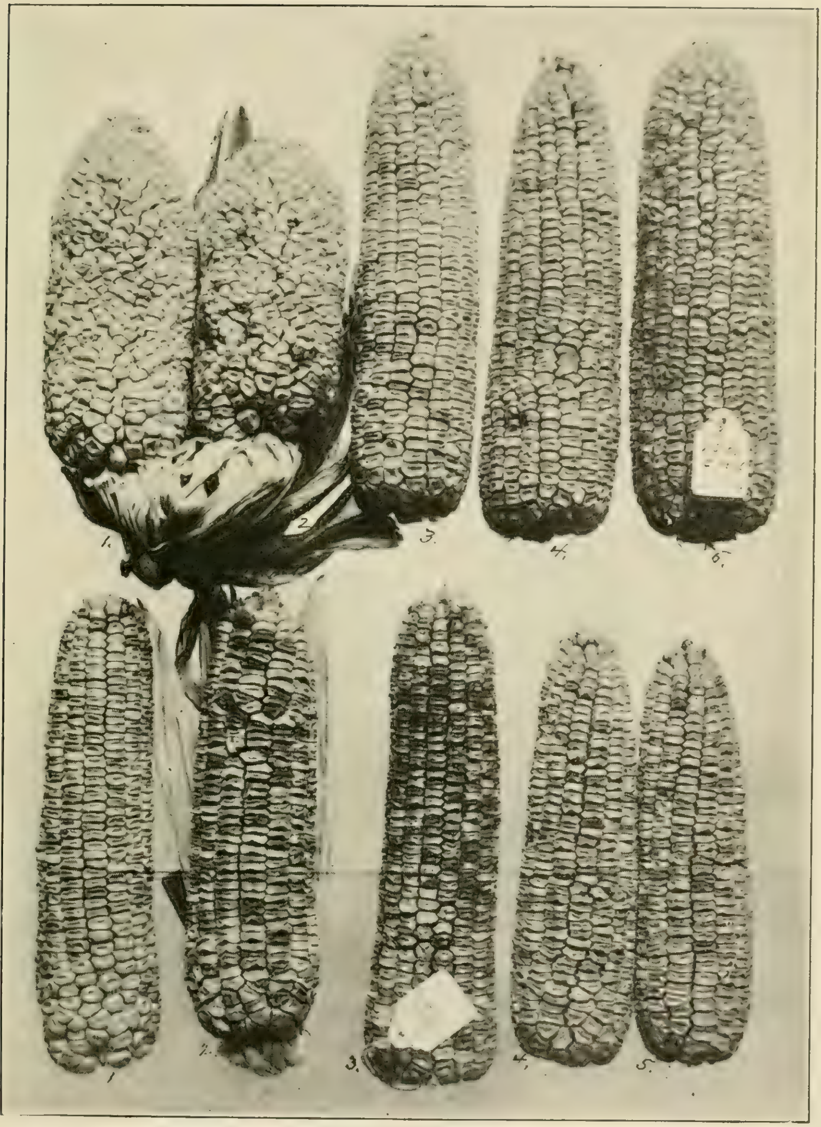

PLATE III. *Crosses of Field upon Sweet Corns.* The upper half shows another set of the "Silver Mine-Country Gentleman" cross with twins having the husks attached. In the lower half is the result of a combination of "Pride of Nishua" upon "Stowell" with twin ears shown at the right.

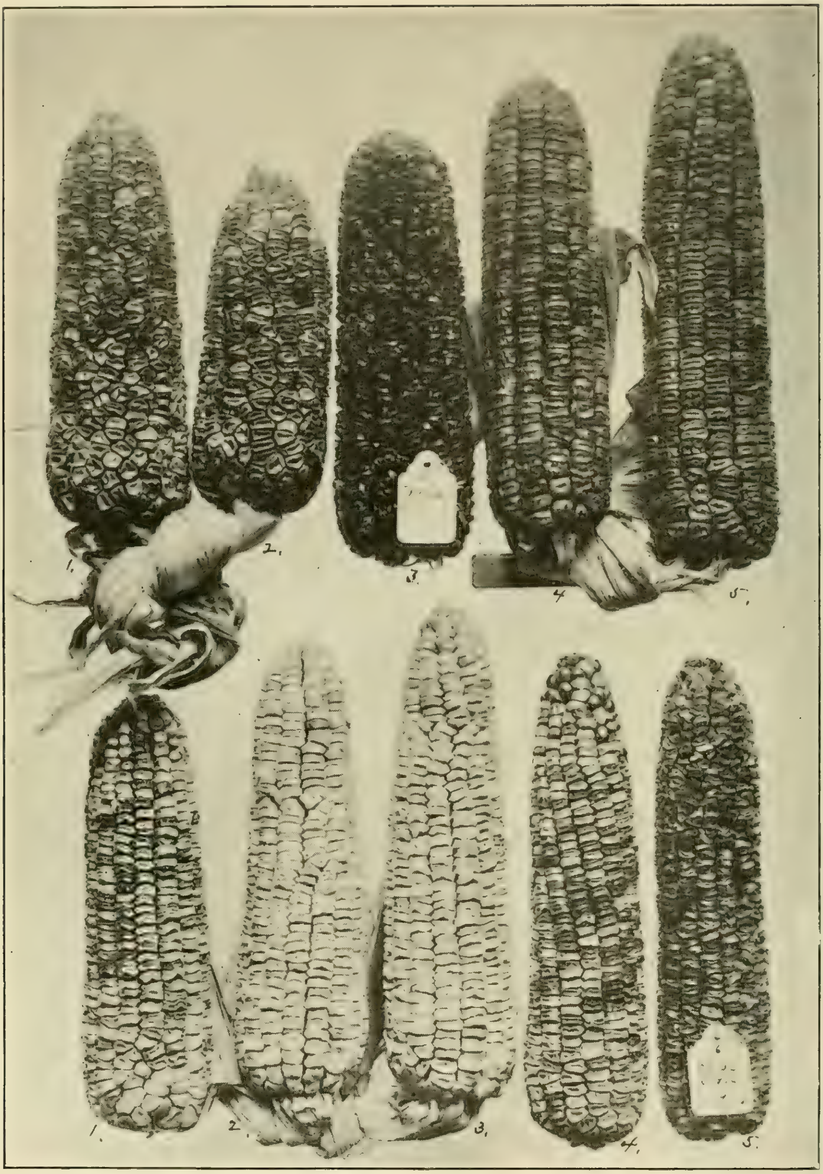

PLATE IV. *Crosses of Field upon Sweet Corns.* The upper half shows two quite different pairs of twins of "Pride-Stowell," the single labeled ear being fully dried. In the lower half are samples of the "Pride-Country Gentleman" cross, those united by their husks being twins and still quite green.

sweetness is shown in the middle position, furthermore, it is entirely yellow and, withal, a very desirable kind of ear for table use, the size being acceptable and the depth of grain desirable.

"PRIDE OF NISHUA-COUNTRY GENTLEMAN" CROSS (145-19)...

In this block (6) the seed for planting was selected from three ears and was both white and yellow so that the ears are quite generally mixed as to color. The plants were of good size, considering the quality of the soil and the unfavorable season and the number of twins was large and big enough for the table. In the engraving (Plate IV) a well-shaped ear is shown at the left of the lower row, a few of the grains of which are flint due to the unavoidable nearness of a block of field corn. White twin ears (not yet dried) are shown with husks tied together, while two other single ears are seen to the right in which the dark and light grains are intermixed. Here again are the flint grains, near the tip, from foreign pollination. The last ear, to the right, is the only one of this lot that has the zigzag character of the "Country Gentleman;" other ears, harvested later, showed this throughout their whole length.

"PRIDE OF NISHUA-OLD COLONY" CROSS (145-64).

The yellow sweet grains only of this cross were planted in block 7 and the result is a set of ears that show an average of one-quarter of white grains. As a rule, the ears were short and broad as shown in the upper portion of Plate V, where an inch wide label is placed upon the narrowest ear. The ear to its left shows quite a tendency to develop the grains without order upon the cob. On account of some of the ears having been recently pulled, there is a great difference in the plumpness of the grains in the set shown but these ears, after they became fully dried, were fully wrinkled, thus indicating thoroughly sweet corn.

"PRIDE OF NISHUA-METROPOLITAN" CROSS (145-56).

Yellow sweet grains of two ears were planted in Block 8 and five average ears are shown in the lower half of Plate V. The shape of the ears is fairly constant and usually the cobs are filled out to the end. At the left is an ear, the grains of which are beaked, giving such ears a striking appearance in strong contrast with the smooth end strain with no deep channels between the rows of grain tips. In this cross, the rows are, with few exceptions, in right lines running lengthwise of the ear.

CORN UPON THE SMOCK LAND.

Twelve blocks (four by four hills) of crossed corn were planted upon the Smock Land, namely, four along the eastern and eight upon the western sides. The soil is poor in all parts except two strips where the old fence rows ran across the four acres; this, combined with the drought, made the crop nearly a failure in some plots.

Block 1. *"Golden Bantam"* upon *"Golden Bantam-Ruby"* (34//34/76). There was a fair stand of plants which, upon September 10th, showed thirty purple, twenty purplish and eleven green stalks. This suggests in this cross that the "ruby" color is a dominant one when bred with a variety with the ordinary green leaves and stems. Thirty-nine ears suitable for seed were harvested, of which thirty had a mixture of the white and yellow grains upon a white cob, six with red grains ("ruby") upon "ruby" cob and three with red cob and the mixed yellow and other grains. As with the stalks, there is here strong evidence of a Mendelian character in the "ruby" color that pervades the whole plant but may or may not involve the grains. In Plate VI, upper left-hand corner, three ears of this cross are shown. The one with the tag has the red cob and grains and the one to its left has a red cob and mixed white and yellow grains, while the one to its right is normal as to color.

Block 2. *"Golden Bantam"* upon *"Henderson"* (35/39). This plot was in a very poor place and the plants were so small that only seven sizable ears were harvested, all of which showed the usual percentage of yellow and white grains and one is given at 2 in the plate.

Block 3. *"Golden Bantam"* upon *"Potter's Excelsior"* (34/69). As this plot chanced upon an old fence row, the stand was fair and twenty-five well-shaped ears were gathered having the expected ratio of yellow and white grains. A sample ear is shown at 3 in the plate.

Block 4. *"Golden Bantam-Stowell"* upon *"Golden Bantam-Banana"* (34/83//34/6). The plants were inferior and only four ears were secured for continuing the double cross, one of which is shown at 4. There were no signs of the zigzag of the "Banana."

Block 5. *"Voorhees Red"* upon *"Egyptian"* (160/23). The record for September 10th is that "the plants made a fair stand and were reaching maturity." Twenty-six ears of good size and shape were harvested, nearly all being twelve-rowed and showing the mixed color of red and white that was characteristic of

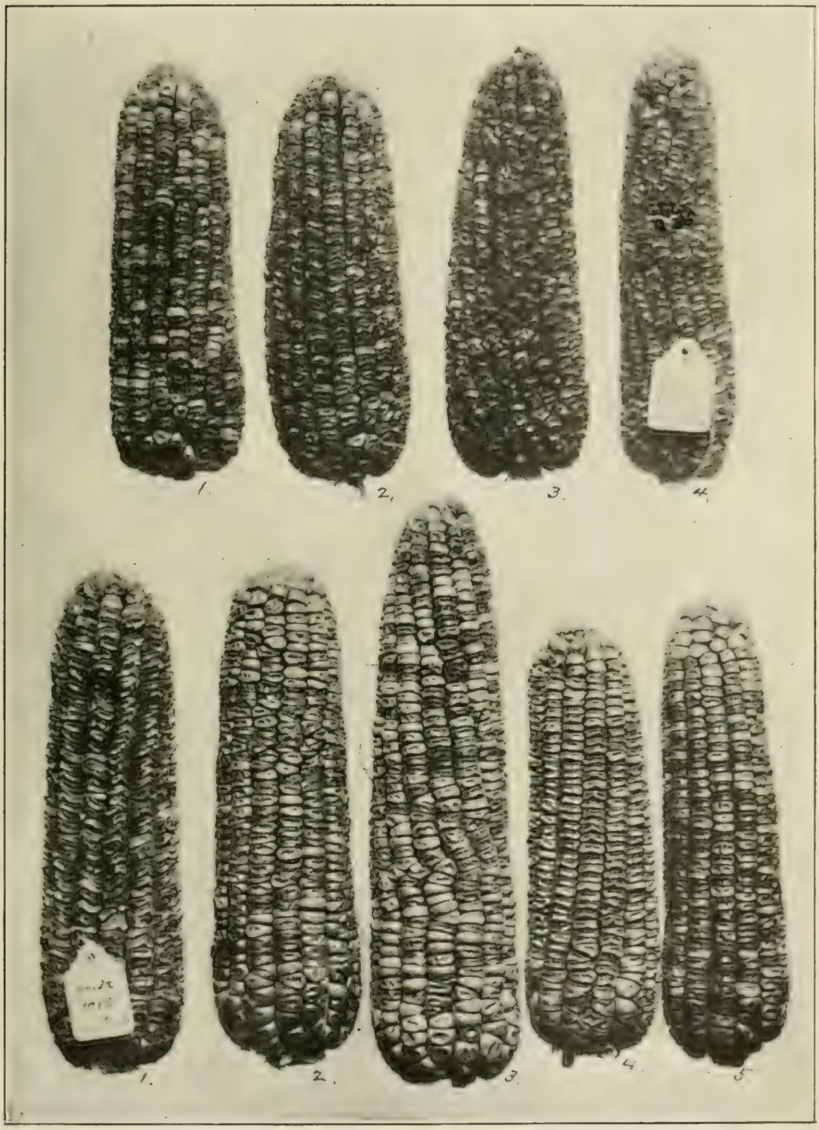

PLATE V. *Crosses of Field upon Sweet Corns.* In the upper half are four ears of "Pride-Old Colony" and below are shown samples of the "Pride-Metropolitan" cross; the leftmost ear has sharp-pointed grains.

the union of "Black Mexican" and "Egyptian" when the "Voorhees Red" was in the making. It would seem that the last-named variety has a power of transmitting color as strongly as the "Black Mexican." A sample ear is shown at 5.

Block 6. *"Voorhees Red"* upon *"Golden Bantam-Banana"* (165//34/6). This plot, while not as well situated as the last, was quite like it in the color of grains in the mixed ears, twenty-three of which were harvested including two nearly zigzag from the "Banana" blood, one of which is shown at 6.

Block 7. *"Voorhees Red"* upon *"Golden Bantam-Country Gentleman"* (165//34/19). The sixteen hills yielded thirty-three ears suitable for seed, all of which were of fine shape, usually twelve-rowed and showed a lighter red (pink) in all of the ears than the previous blocks having the "Voorhees Red" as one of the parents. The left six ears in the lower row of the plate are of this cross; there was very little evidence of the zigzag blood.

Block 8. *"Voorhees Red"* upon *"Stowell"* (165/83). The harvest consisted of seventeen ears, all mixed with red and white with some yellow flint that came from a block of field corns not far away. A short ear is shown at 8.

Block 9. *"Voorhees Red"* upon *"Triumph"* (165/88). Only ten ears were secured and these were small as this plot chanced to come in a very poor place in the field. A sample is shown at 9.

Block 10. *"Voorhees Red"* upon *"Black Mexican-Country Gentleman"* (165//99/19). Only five small ears were matured, one of which is shown at 10.

Block 11. *"Voorhees Red"* upon *"Black Mexican-First of All"* (165//99/32). The eleven ears secured were well shaped, twelve-rowed and showed the usual amount of dark and white grains, as indicated in the sample shown at 11.

Block 12. *"Voorhees Red"* upon *"Black Mexican-Kendal's* Giant" (165//99/44). Upon September 10th, twelve mature ears were gathered and later the total of forty-five was secured, all of fine size and eight to twelve-rowed. The plot had fair soil conditions, which was not true of nearly all the other blocks. The six ears to the right of the lower row are of this cross and the two united by their husks were from the same stalk and are of more desirable shape than the longer and more slender ones to the right.

It is likely that some of these last eight crosses may produce pink-grained sorts that will show more speed in coming to table maturity than the common parent of them all, namely, the "Voorhees Red."

THE BREEDER CORN PLOT UPON SMOCK LAND.

The block of land required was sixty-four by two hundred feet, situated upon the Nursery side of Smock Land, one hundred and fifty feet from the grass border, north end. The corn was planted in hills, four by four feet, and fifteen hills across and forty-nine lengthwise of the plot. Planted lengthwise, the breeder rows are Nos. 4, 8 and 12 as follows: (4) "Golden Bantam-Country Gentleman," solid sweet zigzag ear; (8) "White Rice" and (12) "Jones' Sunnyside." Only alternate hills were planted first in the breeder rows and the remaining, three weeks later. Across these blocks, the forty-nine rows extend each with twelve hills of row variety and also additionally including the three hills of the breeder rows as follows: Row 1, "Early Champion," Hills 1, 2, 3, Breeder ("Golden Bantam-Country Gentleman," yellow sweet), 5, 6, 7, Breeder ("White Rice"), 9, 10, 11, Breeder ("Jones' Sunnyside," yellow flint), 13, 14, 15.

In order to separate this breeding plot as far as possible from an area of field corn, it was required to give it a poor piece of soil and this, with the unfavorable season, accounts for the serious approach to a failure in many instances.

"Golden Bantam-Country Gentleman" (Row 4), solid sweet ears. Of the sixty-seven ears, twenty were solid yellow and forty-seven were mixed. Of the zigzag mixed there were seven, and five of the yellow zigzag; the straight-rowed mixed numbered seventeen and the yellow, seven; there were twenty-three mixed intermediates and eight yellow intermediates.

"White Rice" (Row 8). There were sixty-two ears of marketable size and these were all beaked. There were twenty-one ears showing yellow, and one with rose color. The yellow grains were all beaked like the white and of the same size and shape, with varying color.

"Jones' Sunnyside" (yellow flint) (Row 12). There were only twenty-six small ears harvested, the crop being very poor.

Row 1. "Early Champion" (11). There were eight ears only.
Row 2. "Columbus Market" (14). From this but two ears were secured.
Row 3. "Cory" (15). From this plot four small, mixed ears were gathered.
Row 4. "Crosby" (20). Only twelve small ears were secured.
Row 5. "The Don" (22). From this row was harvested eight ears, showing all the breeders.
Row 6. "Egyptian" (23). Twelve ears represented the harvest from this plot.
Row 7. "Early Evergreen" (25). Seventeen ears, showing the "Jones'" decidedly, were secured.
Row 8. "Harris' Extra Early" (38). Two small ears were gathered.
Row 9. "Hickox" (42). Twelve ears were secured and all showed the effect of the breeders.
Row 10. "Kendal's Early Giant" (44). From this were harvested six very small ears.
Row 11. "Kendal's Early Giant" (44). Only seven small ears were secured.
Row 12. "Mammoth Early" (49). There were only six ears.

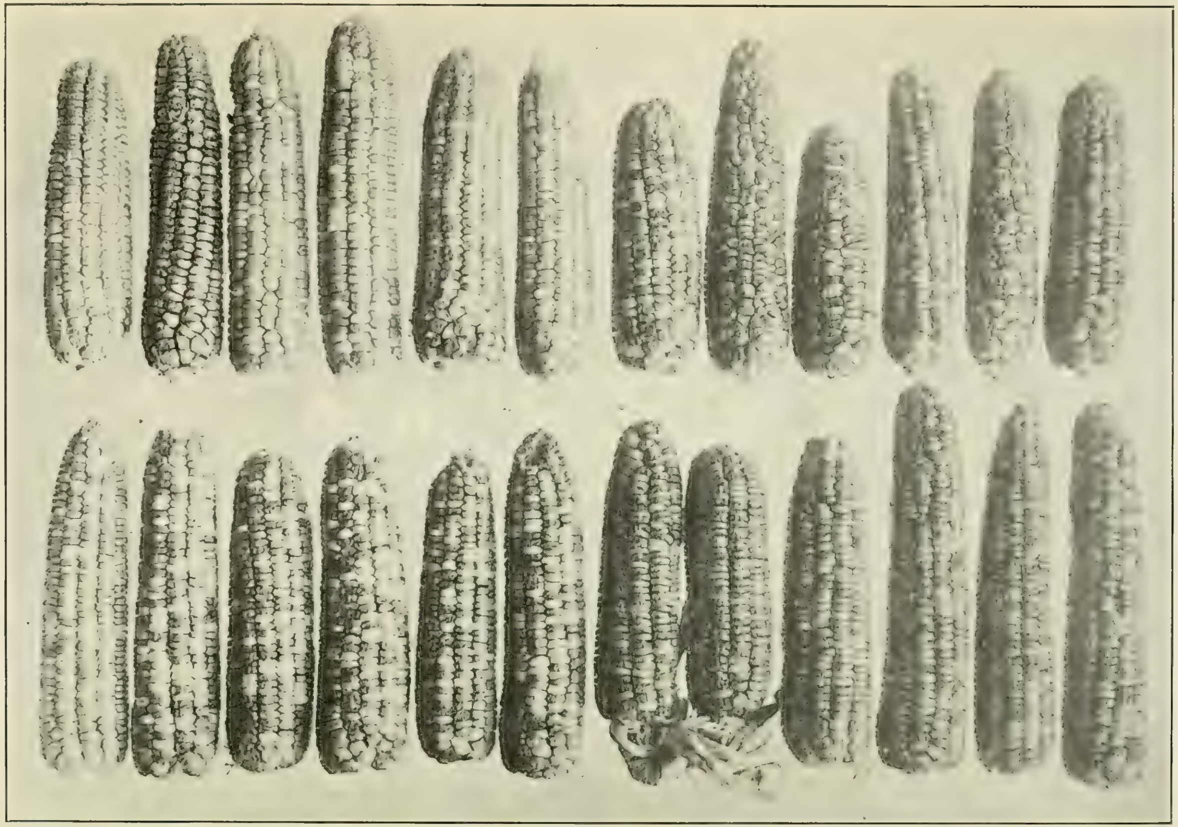

PLATE VI. *Various Crosses of Sweet Corns.* These ears are samples from several blocks of crossed corn grown upon the Smock Land under unfavorable conditions of season and, in most cases, poor soil.

Row 13. “Mammoth Late” (50). Among the eight ears gathered, one ear showed nearly all pop at the tip.

Row 14. “Marblehead Mammoth” (51). From this but eight ears were secured.

Row 15. “Metropolitan” (56). Four small ears were gathered.

Row 16. “Moore’s Concord” (61). Only four small ears were secured.

Row 17. “Ne Plus Ultra” (62). Sixteen ears were secured and four showed zigzag pop.

Row 18. “Perry’s Hybrid” (66). Twelve ears were gathered showing the “Jones’.”

Row 19. “Potter’s Excelsior” (69). Seven very small ears were harvested.

Row 20. “Stowell’s Evergreen” (83). But two ears were secured.

Row 21. “Garwood” (94). From this plot, sixteen short, stout ears were picked.

Row 22. “Early Harvest” (149). There were fourteen ears from this plot.

Row 23. “Buckbee’s New Early Sunrise” (153). There were but nine very small ears.

Row 24. “Early Express” (154). Eleven ears showing “Jones’ ” were gathered.

Row 25. “Extra Early Premo” (155). There were seven ears.

Row 26. “Floracroft Beauty” (156). There were only five ears and these were small.

Row 27. “Livington’s Broad-Grained” (158). Twelve large ears, showing breeder, were gathered.

Row 28. “Nectar” (159). From this row there were thirteen ears.

Row 29. “Rennie’s XXX Early Table” (160). Only six small ears were gathered.

Row 30. “White Perfection” (161). Fifteen ears, all a little pop, were secured.

Row 31. “Long Island” (162). Twelve ears were gathered, all of fair size and showing pop.

Row 32. “Gwilliam” (164). There were seventeen small ears from this row.

Row 33. “Adams-Crosby” (2/20). This row was planted with sweet grains from solid sweet ear, 1st. There were ten ears and three of these showed mixtures.

Row 34. “Adams-Crosby” (2/20). This plot was planted from solid sweet ear, 2nd. Twenty-three ears were gathered, not all of them good ones, and some showing breeders.

Row 35. “Golden Bantam-Banana” (34/6). White grains from mixed ear No. 33 were used for this row. Out of the fifteen ears there were four zigzag and six intermediate. The zigzag showed the three breeders.

Row 36. “Golden Bantam-Banana” (34-6). A solid white twin ear No. 4 was used for this row. Fifteen ears were gathered, showing much pop, and five were intermediate.

Row 37. “Golden Bantan-Banana” (34/6). This row was planted with white grains from mixed ear No. 84. Sixteen ears were secured, the intermediates numbering eleven and the straight rowed, five.

Row 38. “Golden Bantam-Country Gentleman” (34/19). While ear No. 12 was used for planting this plot. Nineteen ears were secured, six being zigzag and thirteen intermediates. They show all breeders.

Row 39. “Golden Bantam-Country Gentleman” (34/19). Zigzag ear No. 13 was used for this plot. Fourteen ears were gathered, the zigzag ones numbering five and the intermediates nine.

Row 40. "Golden Bantam-Premier" (34/70). Solid white ear No. 5 was used here. Fourteen ears were harvested, all being of fair size and showing breeders.

Row 41. "Golden Bantam-Premier" (34/70). This row was planted with solid white grains from ear No. 6. There were sixteen medium-sized ears gathered.

Row 42. "Golden Bantam-Stowell" (34/83). White grains from mixed twin ears were used here. There were twelve ears secured.

Row 43. "Golden Bantam-Stowell" (34/83). This row was planted with amber grains, not long, from single ear No. 32. Fourteen mixed ears were secured.

Row 44. "Malamo" (95/71). This row was planted with amber grains. The fifteen ears gathered showed "Jones'."

Row 45. "Iowa Silver Mine-Country Gentleman" (144/19). Sweet grains from ear No. 14 were used for this row. Twelve ears were secured and one was zigzag and three intermediate.

Row 46. "Iowa Silver Mine-Country Gentleman" (144-19). Two straight rowed ears were used here. Ten good-sized ears were harvested, one being zigzag and four intermediate.

Row 47. "Iowa Silver Mine-Stowell" (144/83). This row was planted with white sweet grains; a fair crop with one ear mixed.

Row 48. "Pride of Nishua-Old Colony" (145/64). This row was planted with white sweet grains. Fourteen ears were secured and showed breeders.

Row 49. "Pride of Nishua-Metropolitan" (145/56). Here white sweet grains were used. There were nine large ears.

COB COLORS.

The "Pride of Nishua" is a large field variety of dent corn with the so-called "red" cob, but to be more exact the exterior of the cob is a shade of "old rose." This color is confined to the chaff and the central cylinder of pith is as free from any color as the same portion of a "white" cob. The cob color is an ear character, that is, it does not seem to matter what the individual grain may bear in coloring substance, whether black, yellow or white, the whole surface of the cob is of the same general tint.

In the crossing of the above-named "red" cob field corn with "Stowell," "Country Gentleman," "Old Colony," "Metropolitan," etc., there was a combination of a "red" cob with a "white" cob sort in each case. It, therefore, becomes of interest to note the effect that the unions had upon the subject of color of the cob.

After the ears suitable for seed-saving were gathered, the remaining ears were examined in the field as to their cob color with the following results:

1. "Iowa Silver Mine-Stowell's Evergreen" Cross; All white cob excepting one showing the rose.
2. "Iowa Silver Mine-Country Gentleman" Cross (pinkish grain plot): All white cob excepting four with the rose color.
3. "Iowa Silver Mine-Country Gentleman" Cross (white zigzag ears): All white cobs.

4. "Pride of Nishua-Stowell's Evergreen" Cross (white grains): Old rose, 28; intermediate, 0; white, 17.
5. "Pride of Nishua-Stowell's Evergreen" Cross (yellow grains): Old rose, 35; intermediate, 3; white, 14.
6. "Pride of Nishua-Country Gentleman" Cross: Old rose, 44; intermediate, 4; white, 17.
7. "Pride of Nishua-Old Colony" Cross (yellow grains): Old rose, 34; intermediate, 4; white, 7.
8. "Pride of Nishua-Metropolitan" Cross (yellow grains): Old rose, 36; intermediate, 16; white, 16.

It is seen from these figures that in all the last five cases, the "red" cobs greatly outnumber the "white" cobs and the intermediates are generally exceptional. When the totals are compared, it is noted that the whites are near to one-quarter of the whole and, in this respect, approach the number that is called for in case the cob color is a unum that observes the Mendelian law. Counting the "intermediates" with the "red" cobs, the totals are with colored cobs 204 and the white cobs, 71, while under the Mendelian rule the ratio of 3 to 1 would give 206.25 to 68.75, which is as near as might be expected where so few instances are involved. If the white cob is a recessive unum, it follows that plants of the cross having it may be expected to breed true to this same peculiarity.

A colored cob is not desired, all other qualities remaining the same, and therefore it is preferable to establish cross-breeds with white cob strains. Should the grains from "red" cob ears be used, it is expected that they would yield a fairly definite number of "red" cob and "white" cob ears, namely, eight of the "red" to one of the "white" type, with the latter diminishing with each succeeding generation when the "white" ears are invariably excluded when selecting the seed for planting.

The fact of the intermediates demands attention for, under the rule of dominance of the "red," they are puzzling. An examiation of a pile of cobs of any field sort of corn usually reveals the fact that a great variation in the amount of color in the cob is the rule. Whether this is due to the presence of "white" blood and a failure of the "red" to fully dominate it is a possibility; but a variation in color among pure "red" ears is not a fact that is, apparently, at all exceptional. While a color in itself may be very constant, it is rare that shades innumerable do not appear, due to a greater concentration or dilution of the coloring substance, if one may so express it, without attempting to give the reasons for such variability.

EXPERIMENTS WITH TOMATOES.

Twenty-three hundred tomato plants were grown at the Home Grounds, occupying Series III, IV and V, with the exception of the space required by the corn blocks and the "Seeding Camp." Sixty old varieties and fourteen novelties were grown, four to eight plants in each, for purposes of study and further work in crossing. The remaining plants consisted of one hundred and ninety-eight crosses, the majority of which were compound and included twenty-two combinations in the blend stage.

Weather conditions at the time of transplanting (May 15th) were very favorable so that the young plants received no check but the severe drought of mid-summer diminished their growth and, even though irrigation was resorted to, the foliage of many plants curled and the yield of fruits, which cracked badly, was lessened.

A test was made of tying the plants to stakes, fence pickets four feet in length being used. A portion of the tomato plots is shown in Plate VII as they appeared in late autumn after the tops of the plants had been permitted to grow without pruning for two weeks, the tops hanging out in all directions from the stakes to which the main stems were secured by stout twine. This method is much superior to the low metal holders and the keeping of the fruits from the ground makes it easy to study them in full view in all stages of their growth as they hang upon the plant.

INCREASING THE LENGTH OF FRUIT.

For three years, special effort has been made through cross-fertilization, inbreeding and selection to increase the length of the fruit, with the aim of securing a type which has been termed the "goose-egg." It is desired as well to improve the interior, so that the internal structure shall be many-celled, fleshy, solid and comparatively seedless.

The "pear" and "plum" varieties, being of the desired form and length, have been crossed with large-fruited sorts in many instances but they greatly reduce the size of fruit and number of seed cavities. A majority of the compound crosses grown this season, made with the idea of securing a longer fruit, represented plants from seed of hand-worked and choice selected fruits. These crosses have been divided into two groups, namely, (1) promising and (2) less promising.

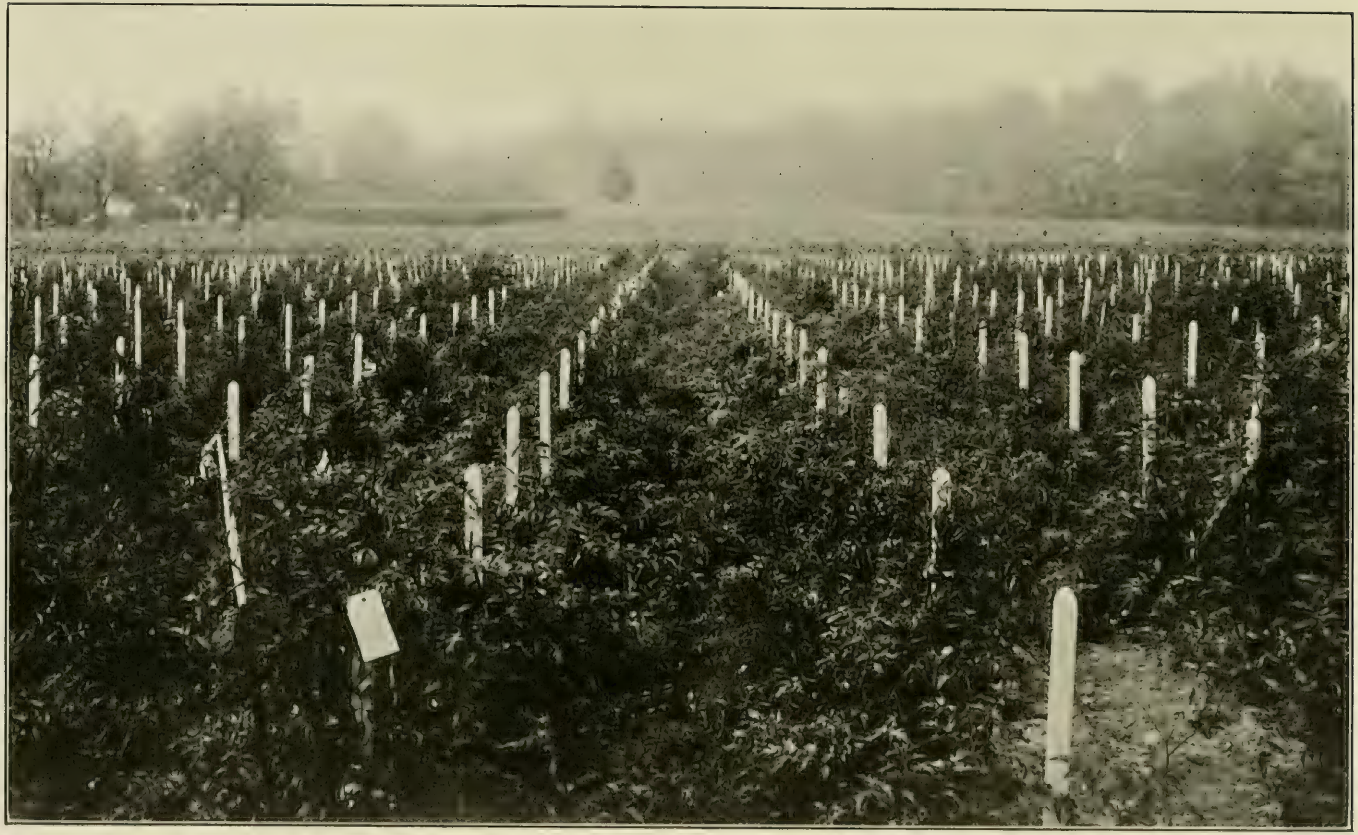

PLATE VII. *Tomato Field Area* showing the method of using stakes for holding the fruits from the ground. Photograph taken late in the season after pruning had ceased.

PROMISING CROSSES.

1. *"Crimson Cushion-Ponderosa"* (26/103). An interesting type made its appearance in this cross represented by two plants bearing medium-sized, long fruits which were of a striking pale green when immature and when ripe resembled the pink "peach" variety. The interior was flabby but on account of its color and good length it is reserved for further breeding. Another promising plant was a heavy bearer of a uniform lot of medium-sized, long, smooth, red fruits with a solid interior.

2. *"King Humbert-Ponderosa"* (64/103//103///64/103). The "Humbert" does not reduce the size of the fruit in its crosses to the extent of the "pear" and "plum" sorts but its tendency is to transmit the flabby interior so that, in the case of the above union, the amount of "Ponderosa" blood was increased. The past season gave twenty plants in this set with either pink or red fruits, medium small and medium long, many being inclined to the "fig" shape. The interior took on the character of "Ponderosa" with four or more cells, "Humbert" having but two. Being further combined with "Magnerosa" last year, the blend plants of this season were very thrifty, medium early in season and prolific, bearing rather small, long, pink fruits whose interior was excellent. They need only an increase in size to make them highly desirable.

3. *"Ponderosa-Sumatra Fig"* (103//103/181). At least two-thirds of this set showed a desired length combined with an interior better than that of the "Fig." This is one of the best combinations yet made in the effort to produce the ideal "goose-egg" and, when united with other choice crosses, has yielded very desirable fruits.

4. *"Ponderosa-Sumatra Fig-Magnerosa-Globe-Magnus"* (103//103/181///227//194/75). Plants of this complicated cross represent some of the best standard varieties on the market to-day. The "Ponderosa" contributes the fine interior, while its flatness is overcome by the length of the other sorts. Both pink and red fruits resulted and all were either of the "apple" shape or long, many approaching the "goose-egg" in form, falling short only in size and interior. Ten of the fruits of this combination are shown in the four-quart basket at 1 in Plate VIII.

5. *"Globe-Magnus"* (194/75). This combination gave prolific plants, many with good-sized, long, pink fruits and solid meaty interior while the fruits averaged larger than the cross preceding, as there was no blood of the "Sumatra Fig" to reduce the size; they fall below it in average length, however.

6. *"Magnus-Ponderosa"* (75/130).—(*"Magnerosa"* 227). This cross gave fruits in some cases whose polar axis surpassed even that of "Magnus." During 1907, fruits with very promising length as well as good interior were obtained and, after further inbreeding and selection, a block of one hundred plants was grown this year, one-half of which have given fine, long, medium sized, pink fruits with a solid interior. Such excellent results from this cross show that work within two standard varieties proves effective in gaining a desired end. Eleven fruits of this variety are shown in basket 2 in Plate VIII.

7. *"Magnerosa-Earliana-Jewel"* (227//33/66). Plants of this combination have given, in the majority of cases, a good-sized, medium long, smooth, red fruit which, by selection promises a red "goose-egg."

8. *"Magnerosa-Giant-Globe"* (227//56/194). This cross has given some very interesting plants, whose medium-sized, long fruits possessed the peculiar green color noted under 26/103, and when ripe turned to the characteristic "peach" pink color. Nine fruits of this cross are shown at 3 in Plate VIII.

9. *"Magnus-Ponderosa-Sumatra Fig"* (227///103//103/181). This compound cross involved three varieties and was represented by sixty plants, many of which produced fruits of good length, as shown in basket 4 of Plate VIII. The fruits did not average as large as those in basket 1 where there was, in addition the blood of "Magnus" and "Globe."

10. *"Magnerosa-Globe-Magnus"* (227//194/75). The plants under this group were strong growers and prolific bearers of good-sized, long "apple," pink fruits whose interior was above the average and resembled that of the "Magnerosa." The fruits in themselves were not long enough for a "goose-egg" but furnished an excellent interior to combine with length as found in the "Ponderosa-Fig."

Comparing the above crosses as a whole with the ideal, the form is found to be nearer realization than the internal structure. When once the "goose-egg" form is fixed, individuals which combine with it the best interior should be bred together and selection then made with the ideal of internal structure in mind.

LESS PROMISING CROSSES.

"Earliana-Jewel" (33/66). The fruits of this combination, while longer than those of the "apple" type, are medium-sized and seldom give more than four locules to a tomato. Combinations of this union, however, with larger-fruited crosses as, for example, 33/66///227//194/75, give more promise.

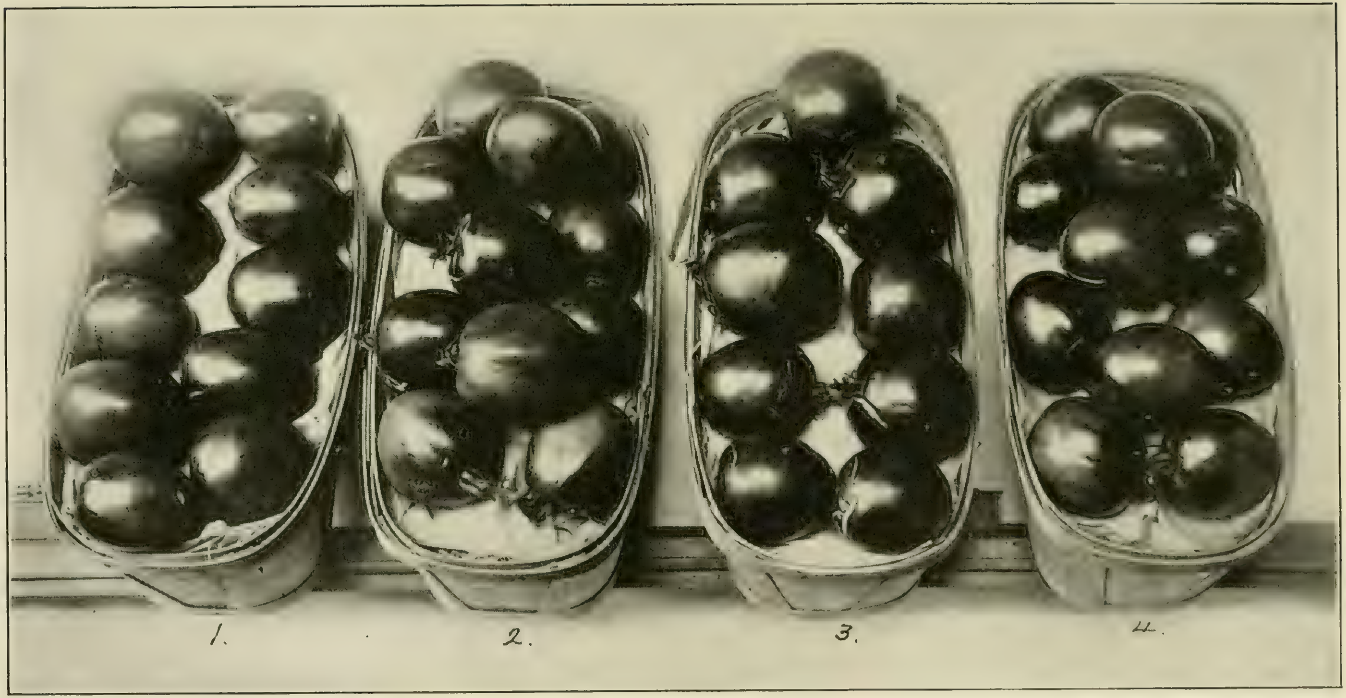

PLATE VIII. *Tomato Fruits.* Four sets of crosses showing promising "goose-egg" form and size, photographed in a surface layer in four quart baskets.

"Humbert-Fortune-Ponderosa" (64/57//64/103). Fruits of this cross are lacking in good flesh, which is flabby; they are of medium size, good length and average four cells. More of the "Ponderosa" type is needed.

"Magnus-Crimson Cushion" (75/26). This combination gives a medium-sized fruit with a good interior but the length has not exceeded the "apple" form.

"Ponderosa-Sumatra Fig" (103/181). This cross in itself giving a long fruit, falls far below the ideal in size and internal structure, which defects as seen in No. 4 of the "Promising" set, are being removed by introducing the blood of such varieties as "Magnerosa," "Globe" and "Magnus."

"Earliana-Yellow Peach" (33//37/186). In this cross, the length of fruit is desirable but not the size and internal structure. Further breeding, to supply the desired qualities, promises an interesting "goose-egg" with the foliage and hairiness of the "peach."

THE DISTRIBUTION SET OF TOMATOES.

All but one of the six crosses distributed to the testers were grown upon the Home Grounds during 1908.

Station Tomato No. 7. ("Dwarf Stone-Golden Queen"). The strong plants were, like the "Stone," late bearers of large, smooth, solid, cherry red fruits.

Station Tomato No. 8. ("Globe-Brinton's Best"). Thrifty, prolific plants resulting from this cross bore good-sized, round, pink fruits with an excellent interior. Cracking was a noticeable defect, due largely to weather conditions.

Station Tomato No. 10. ("Magnus-Dwarf Champion"). The upright, stocky plants, medium late in season, were good bearers of medium-sized, round, smooth, pink fruits which did not crack.

Station Tomato No. 11. ("Arcadia-Earliana"). The fine-leaved standard plants did not make a large growth but were among the first to set fruits, which at maturity were of medium size, smooth, solid and red.

"Oligosperm" (few-seeded). The plants, ten in number, while late in season, made a good growth and were readily distinguished by their distinct foliage. The fruits, all pale yellow, were medium-sized, round and smooth with few seeds, some having less than five. Thirty attempted crosses upon the "Oligosperm" resulted in eight ripe fruits but none contained seeds.

REPORTS FROM TESTERS OF STATION TOMATO NO. 7.

("DWARF STONE—GOLDEN QUEEN").

(1) "The plant was vigorous and productive; the fruit was quite uniform." (2) "The fruit was bright red and not very large. The plants were very thrifty." (3) "Fine sturdy plants with firm, smooth fruit of excellent flavor were secured. The plants gave an abundant yield." (4) "The plants were healthy and productive. Fruit was uniform and of medium size and red in color." (5) "This tomato is the best we have ever had. It has a strong vine and large fruit which is light red and of very good flavor." (6) "The tomato was fine, the weight of some being over sixteen ounces and the average being about twelve ounces. The color was on the pinkish-red shade and the shape was good; some that were cut were almost solid with very few seeds. The foliage was free from blight while other varieties blighted badly." (7) "This is a large, thrifty plant; the large, round, solid tomatoes are a light red and have an excellent flavor, fine for canning and table use. They are the heaviest tomatoes that I have ever seen, are very productive and full of fruit." (8) "I set out the plants in the middle of May and had tomatoes till now (October 10th). The plants have a solid growth and bear large, firm tomatoes." (9) "These tomatoes are very fine, I raised twenty plants from the seed you sent. The fruit is uniform throughout, large and smooth. I have had them weigh from twelve to twenty ounces each. This is a very fine fruit for table use and excellent to can." (10) "They are very fine tomatoes." (11) "The plants are vigorous and productive. The fruit is round, smooth and large. The flavor is superior." (12) "I sowed the seed March 10th and they ripened July 15th and are still bearing September 25th. A good strong plant, fairly prolific, uniformity red, smooth fruit with good flavor." (13) "The plant is large and thrifty. The fruit is a deep red, of uniform size and very solid." (14) "I think your tomatoes are very fine. The plant is large and vigorous with plenty of fruit of medium size and of a good solid red color. I am saving what seed I can out of the smoothest and largest." (15) "The plant is very productive with round and uniform fruit." (16) "The plants were thrifty and stocky and grew very tall. The tomatoes were smooth, solid and fine." (17) "The tomatoes came up well, strong vigorous plants with round, smooth fruit of very fine flavor." (18) "The vines are quite vigorous growers and yet open in form so the sun gets easily at fruits. The fruits are set in quite large clusters, perfectly round, ripen evenly and clear up to stem. They are fleshy with little core and the quality is good, showing no rot or tendency to crack on vines." (19) "The color is bright red, the fruit is medium to large and vigorous. The fruit remains firm four days after picking." (20) "The color of fruit is bright red, the shape, size and solidity are desirable." (21) "My results were most gratifying. The vines were most vigorous (so much so that I had to prune severely), bearing quantities of tomatoes." (22) "The seed came up very quickly. The fruit did not rot or crack. I think this variety will soon be the leading kind for market, the fruits being large and round." (23) "This is a fine early tomato." (24) "The plants grew to a large size and were very vigorous. The color and shape of the fruit were good and the quality was fine." (25) "Plants of fair size, productive, with fruit of good size and very smooth." (26) "The plants grew very large and bore a great many fruits. The fruit was very round and firm and light pink in color." (27) "This variety of tomato produced very smooth, round and good quality fruit. The vines were very healthy and we were pleased with the tomatoes. The color of fruit was red and the productiveness of plants was fair." (28) "The tomato was very satisfactory, the fruits being large, round, solid and with few seeds." (29) "The fruit is medium to large, of good shape, smooth, round, and no pit at stem." (30) "The tomatoes were excellent, being large, solid and smooth with a fine flavor. They are as good as the best to be found." (31) "The tomatoes grew to a large size and were very smooth;

the plants were vigorous and of upright growth." (32) "The plant was very large and strong. The fruit was variable, most of it being very small. There were a few very large ones of good shape and fine flavor. (33) "The vines were very dark in color and very healthy. They were trained on poles and grew seven feet high. The tomatoes are nice and large, smooth and of good flavor." (34) "These tomatoes were very good considering the dry weather; the fruit was of good size and color." (35) "The fruit is small, round and solid. The vines bore plentifully." (36) "This is of good quality." (37) "The color of this fruit is bright red, the size is uniform and the quality is good." (38) "This was the finest-flavored tomato of its kind I ever tasted." (39) "The plant is strong and dense, bearing red fruit with small cores." (40) "Vigorous plant; fruit bright red and of uniform shape." (41) "This tomato is very nice; the fruit is very solid and of excellent quality." (42) "This tomato was fine, quality good and color red."

REPORTS FROM TESTERS OF STATION TOMATO NO. 8.

("GLOBE-BRINTON'S BEST.")

(1) "The vines were strong and thrifty and the yield was medium. The fruits were of medium size, uniform shape and very smooth." (2) "The fruit is smooth and nice, not very large but solid." (3) "The tomatoes are fine and smooth and very uniform." (4) "This strain of tomato was very prolific with erect vines. It was a prodigious bearer of smooth and well-formed fruit. A very desirable kind for table use." (5) "The tomatoes are large and the plants are thrifty." (6) "The vigorous vines were six feet long from root to tip. There are at least seventy sets on some of the vines. Most of the tomatoes are round and smooth, with a color between pink and purple. They ripen up nicely and are very good tasting and solid." (7) "I found this tomato grew very well for me. The plant grew quickly, large and bushy, and the fruit was a medium size and very smooth." (8) "The plant is thrifty, the fruit is a fine shape and firm, and of fine flavor." (9) "These plants grew a strong, healthy vine and yielded a good average crop of tomatoes, nearly but not quite globe shape." (10) "There were many tomatoes of fine uniformity in size and color." (11) "The tomatoes were of good size, being round and of uniform size; the plants were productive." (12) "The tomatoes were of medium size, very smooth and solid." (13) "The tomato was fine, being large and round in size. The vines grew very large and were thrifty." (14) "The tomatoes did well and grew to a nice size." (15) "This is a good tomato and the plants are very prolific. The fruit is of good size and shape, being very deep from stem to blossom end; the flesh is solid, the quality of the best and the color is handsome. The tomatoes ripen well and are very uniform." (16) "The tomatoes are a rich, very solid and large, some weighing one pound." (17) "This tomato is the finest I ever raised; it is of fine flavor, a good yielder and ripens early." (18) "I find great satisfaction in this tomato. The plant is large with an abundance of fruit. The fruit is large with a very smooth surface. The tomatoes have a fine taste." (19) "I succeeded in raising fifteen plants, which were quite large and filled with fruit of medium size with a few large ones. The fruit was perfect in shape and very smooth; the quality was extra good." (20) "The color of this tomato was bright red. The fruit was small but perfectly smooth. It ripens to the stem. The vines grew the length of five feet. The flavor was good." (21) "The plants grew very large and bore a great many fruits. The fruit was very round and firm." (22) "In spite of the dry season, your tomatoes grew with much vigor to an unusually large size and produced fruit in abundance. The fruit is very smooth and plump." (23) "The plant is large, very vigorous and productive. The fruits are uniform in shape and very fine." (24) "This tomato is unexcelled for firmness and flavor. The color is light red and the shape globular. The fruit does not crack like some varieties." (25) "Speaking of this tomato, I would say that it is fine.

The seed was started under glass, set out the first week in May, picked the first ripe one on June 27th; I have been picking ever since and the vines are still full of green fruit (September 1). The plants were staked to Lima bean poles eight feet high and the vines are at the top and at this writing still full of vigor. It goes ahead of any early tomato that I ever tried." (26) "The tomato is very nice and solid." (27) "The fruit is of a uniform size, nearly perfectly round and a light red color. I think this tomato would be a good one to raise for market to sell by weight on account of its growing so solid." (28) "Tomatoes were of good quality, light red color and very productive." (29) "The tomato which you sent me is certainly fine. It is very solid, has very few seeds and is a light red. I consider it a fine tomato and the vines grew large. I sold two baskets and the man said the fruit went ahead of any he had ever had. The tomatoes remained solid until used up and did not get watery. The fruit grew very large and smooth, round and solid." (30) "The tomatoes were very nice and they measured from eight to ten inches around. The color was a pale red and the plant was about two and a half feet high. The tomatoes were very smooth and round." (31) "The plants were transplanted in April and grew quickly. We had large red ripe tomatoes by July 15th." (32) "This tomato was extra early; in fact, was first of all. It was round, smooth and solid." (33) "The vines grew to medium size, the fruit was large and round. The flavor was fine and the fruit was very meaty." (34) "A productive purple tomato. It is nearly round, very solid and of good size." (35) "This is very prolific, the fruit is about one and a half inch or less in diameter and is nice and smooth. The plant is a vigorous grower and the fruit is red and very round." (36) "The plant is of medium size and very thrifty in appearance. The fruit is of good size and oval in shape." (37) "This is very productive, not quite so vigorous as the 'Acme;' fruit uniform in size." (38) "The size of this tomato is medium. The plant is vigorous and productive. The fruit is round, red and very uniform." (39) "I was much pleased with this kind of tomato; the plants bore abundantly. The fruit is perfectly round and very smooth and of fine flavor, being red in color. The vines grew about five feet high; this variety cannot be praised too highly for its fine quality." (40) "The color of the fruit is red. The plant grew very well." (41) "The plant is of a large size and is a vigorous grower and very productive. The fruit is of good size and long or apple shape." (42) "The plants were big and strong; the color was red and the size was medium. The fruit was very nice and very meaty."

REPORTS FROM TESTERS OF STATION TOMATO NO. 9.

("GLOBE-HONOR BRIGHT").

(1) "The tomatoes were very large and smooth." (2) "These tomatoes are very large and smooth, of good flavor and the plants yield abundantly." (3) "The tomatoes were a nice round shape, very red and firm. They are good bearers and the plants were large." (4) "The color is bright red. The plants are very productive and the fruit is very smooth, of fine size, excellent flavor and perfectly round." (5) "The tomatoes are very fine, not so large but very smooth and very early and the plants are great bearers." (6) "The tomatoes are very fine, good flavor and all right in every respect." (7) "The tomatoes are all right. The plants were not so large but the tomatoes were fine." (8) "The tomatoes are superior to any I ever raised. As for quality they are superior. The color is bright red and the size is twelve inches. There are no cracks around stem caused by wet weather as is the fault with other varieties. The shape is uniform and smooth. I think there is no better variety grown." (9) "The plants were large and thrifty and were well filled with fine, bright red fruit; they were medium early. The bearing kept up till frost came. The fruit was of very good quality." (10) "This is an excellent variety for productiveness. The fruit is light red with little core, much meat and of the best quality."

REPORTS FROM TESTERS OF STATION TOMATO NO. 10.

("MAGNUS—DWARF CHAMPION").

(1) "A very smooth tomato that ripens close to the stem and is free from cracks. The color is purple." (2) "The plant is of a very sturdy habit of growth and noticeably different from the ordinary varieties because of its thick stem and blue green foliage. The fruit, set in twos, was very symetrical and of medium size." (3) "A fine tomato of slow but healthy growth and foliage of the potato type. Very productive. The fruit is very uniform, a deep pinkish red color, round shape, solid, very handsome and free from disease." (4) "The tomatoes are very nice; they are light red, four inches across and do not rot." (5) "The size of the plant is thrifty. The size of the fruit is medium, the color is pink and the yield good." (6) "Fruit large, smooth, of a pink color. Plants were vigorous and produced well. I had 'Dwarf Champion' so I could compare both; this is an improvement." (7) "The tomatoes grew about two feet high. The fruit was rather small, even and round in shape. The color was dark pink." (8) "This cross is very productive of pink fruits, which are smooth, juicy and with a solid core."

REPORTS FROM TESTERS OF STATION TOMATO NO. 11.

("ARCADIA-EARLIANA").

(1) "This tomato is very fine and large, very solid, of a light red or pink and with very few seeds. The plants are prolific bearers. The heart of the fruit is very solid and the flavor is fine, the best I ever raised." (2) "The color is a good red and the fruit is fine flavored." (3) "The earliest and best variety. Good size, smooth and red, both outside and inside." (4) "This is fairly uniform in size and quite uniform in shape; average weight is six to seven ounces. Twenty-five plants, to date (September 6th) have yielded one hundred and ten tomatoes, with as many still on the vines." (5) "The plants grew well; the fruits are larger than 'Earliana' but not so many on a plant." (6) "The fruit was very smooth and ripened all over evenly. I believe it will be a profitable tomato." (7) "Had fair-sized plants, with uniform fruit. Quality was good." (8) "The tomatoes were very solid and of good size." (9) "The plant is small and bushy with large, dark red and smooth tomatoes of fine quality. It is a good producer." (10) "The vines were set heavy with fruit early in the season, the first ripe tomato being picked on July 14th. The fruit is large and I prefer it to the 'Earliana.'" (11) "A very fine early tomato of very good size; the strong plants are very productive for an early tomato." (12) "It was a vigorous grower and very productive with smooth fruits." (13) "The tomatoes were of good shape with a deep core and few seeds. A fair crop was gathered. The color of the fruit was bright red and the plant was large and vigorous." (14) "The plants were strong although the drought hurt them. Some fruits were deep red, very smooth and did not crack. They were of fair size and solid." (15) "The vines were extra large. The fruit was large and perfect in shape." (16) "The variety turned out all it was claimed, being very prolific, of a nice red color, almost coreless and seedless and of good flavor. It was of uniform size throughout, of round shape and with a very vigorous plant." (17) "The tomatoes were fine." (18) "The tomatoes were very smooth, round and nice and the vines were large and thrifty. The color of the fruit was a bright red." (19) "The fruit was of good shape, solid and very few seeds. Nothing could be better for the table." (19) "The plant was vigorous, fairly productive, and early. The color was pale red, shape smooth and uniform. It seems to promise well for an extra early variety for family use." (20) "This tomato is equal in size, vigor and productiveness to the 'Earliana.' A more solid fruit, more uniform in shape and of a higher color." (21) "The fruit is of superior uniformity and shape, and in color very fine; it seems to possess extra keeping qualities." (22) "This plant is a

good producer of round, smooth and very good tasting fruit. Fruit is very good for canning." (23) "This variety is vigorous and productive." (24) "This tomato was the finest I ever saw, the plant was of medium height with spreading branches. The fruit which was set thick was of even size and ripened up to stem end. The flavor was the best of any tomato I ever ate. Better than its parent, the 'Earliana.'" (25) "This variety is very vigorous and productive, with fruit like the 'Earliana' but larger." (26) "The plants were large, vigorous and heavily set with fruit." (27) "This variety is one of the earliest and most productive. The vines were spreading and vigorous and the quality of the fruit was good."

REPORTS FROM TESTERS OF THE "OLIGOSPERM" TOMATO.

(1) "The plants show a luxuriant growth, having reached a height of about four feet in fertile soil." (2) "The plants are strong and vigorous and very thrifty. The fruit is very uniform in shape and size." (3) "This plant made vigorous growth in the green house. The stem is thick and strong, the leaves large and very dark green. The flowers were few, small and feeble but perfect." (4) "The size of these tomatoes was large, many weighing ten to twelve ounces. The plant was very vigorous and productive and the fruit was very uniform. The seed spaces are small and few seeded." (5) "These tomatoes are fine, large, perfectly smooth and with very few seeds. When sliced, they are meaty and firm." (6) "We are more than pleased with the tomato. A prolific yielder of fine large yellow tomatoes. Fruit is solid, with few seeds, and of delicious flavor. We are saving seeds to plant next year." (7) "These tomatoes are very fine, plants are large and well set with tomatoes." (8) "The plants are large and very spreading; fruits are solid and meaty. The color is a rich yellow throughout. The fruit is of round shape and uniform size." (9) "This tomato has but few seeds; I could hardly get enough for planting next season. They are fine when spiced." (1) "The plant is strong and healthy." (11) "Rather acid fruit but otherwise satisfactory. Thin-skinned and firm in pulp." (12) "The plants grew to a large size." (13) "The plants grew finely." (14) "The plant is large, the tomato about two inches in diameter with few seeds. The quality is good." (15) "The yellow tomatoes were of very nice flavor." (16) "These tomatoes grew about three feet high, with a large quantity of fruit, yellow in color, round in shape and with very few seeds." (17) "The fruits were round as a ball and the plants were very productive. We consider them very good." (18) "The plants were vigorous and strong." (19) "The fruits were pulpy and few-seeded, with a more delicate flavor than the ordinary tomato. A decided addition to the list of tomatoes." (20) "A bright yellow tomato of fine flavor." (21) "The plants were very vigorous and strong growers." (22) "We found the fruits of this variety to be as large as and quite like the shape of a large apple. On cutting open, they were found to be very solid and with but few seeds. The flavor was fine."

SPECIAL CROSSES.

"Acme-Arcadia-Currant-Ponderosa (1/5//177/103) *Baby Ponderosa."* This odd and interesting novelty, obtained in 1907, has bred true to a flat, pink-fruited type, giving plants much earlier in season than the "Ponderosa." The fruits have a peculiarly mild flavor which suggests the "Currant" parent. This novelty is shown at 10 in Plate IX.

"Aristocrat-Princess" (149/109). The standard, fine-leaved plants all gave the characteristic yellow foliage but they were not

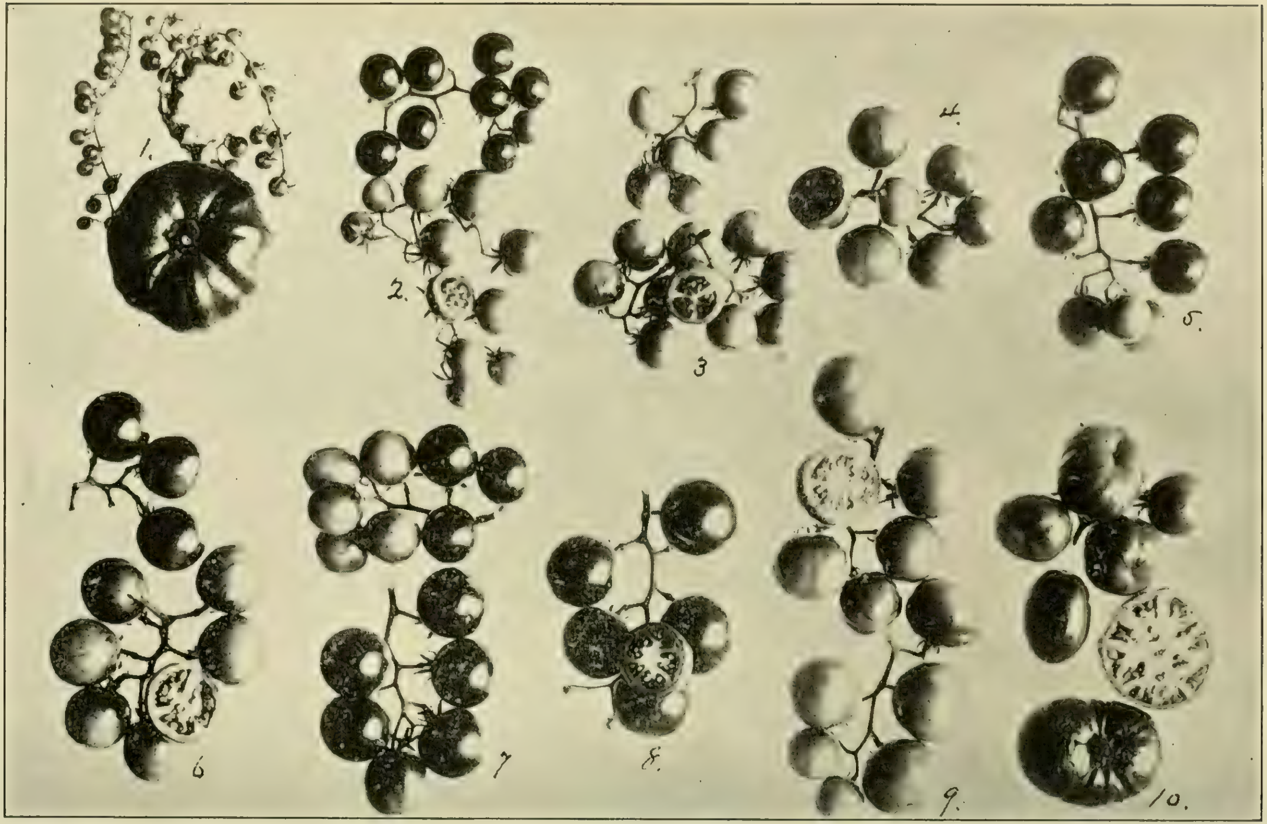

PLATE IX. *Tomato Hybrids.* The influence of the "Currant" species is shown in several combinations with the ordinary commercial varieties of tomatoes.

"sickly" as might be inferred by their general appearance, being good bearers of medium-sized, smooth, pale yellow fruits with a good interior. Aside from being an interesting novelty, this cross is being used to aid in completing the classification scheme.

"Yellow Prince-Currant-Champion" (148//177/154). The plants of this blend were of sturdy, upright growth with dark green leaves intermediate between the fine and coarse type of foliage. The clusters of red fruits, which were as large as the "plum" but apple shaped, were borne in abundance. This is a promising strain for preserving and the stems being nearly smooth add to its interest as a breeder.

"Station Yellow-Dwarf Stone" (210/169). Plants grown from the selected seed of 1907 were upright and medium late in season, bearing good-sized, smooth fruits of an orange color, very striking when compared with the ordinary yellow tomato.

"Station Yellow-Magnus" (210/75). This cross has given, as one of its strains, strong-growing, coarse-leaved plants associated with pale yellow fruits, a rare combination of these two characters which bred true in all the plants.

"Acme-Arcadia-King Humbert-Ponderosa" (15//64/103). This combination has given a "fig"-shaped type of fruit with the interior of the "Ponderosa" and either pink or red-colored fruit. By union with other crosses with pear-shaped fruits, possibly a marketable-sized, many-celled "pear" fruit may be obtained.

THE "CURRANT" HYBRIDS.

The ten groups of fruits pictured in Plate IX represent nine crosses containing "Currant" blood, the parent forms (177 and 103) being shown at 1. This set illustrates a progressive series in respect to size and interior from the small "Currant" to the large "Ponderosa" sort. All are associated with practically smooth-stemmed plants and, with the exception of 2, 3 and 10 represent the blend stage.

The first generation of "Currant-Ponderosa" (177/103 I) is represented by the fruits at 2, whose size and shape combined with form of cluster, approach 177. The average fruit in cross section shows the numerous seeds which crowd the locules and is a further indication that the smaller-fruited parent dominates the cross.

Fruits of "Currant Dwarf Champion" (177/154) pictured at 3, are of the selected type which has been carried to the fourth generation. The influence of 177 is shown in the cluster form; the fruits similar to those at 2 in shape and interior but smaller.

Group 4 represents a cross which is a combination of 3 and 10 (see below), the average fruits with four or more locules being a little larger than those at 3 and similar to them in form.

At 5, "Currant-Dwarf Champion" (3) has been combined with "Ponderosa," "Sumatra Fig," "Magnus" and "Crimson Cushion." The fruits have a longer polar axis than those of the preceding groups and resemble the "plum."

The fruits pictured at 6 resemble those at 5 in general appearance and represent the union of "Currant-Dwarf Champion" (177/154) with another cross composed of the "South Jersey" "Jewel," and "Pear" sorts (177/154///119/66//180.) The locules, while few, are similar in shape to those of the ordinary-sized tomato.

Group 7 shows the hybrid (177/154) combined with the "Ponderosa-Sumatra Fig" (177/154///103//103/181), the medium small fruits indicating by their cluster the influence of 177 and by their length that of the "Sumatra Fig."

The fruits at 8, representing a union of 177/154 with "King Humbert" (64), "Giant Climbing" (57) and "Ponderosa" (103), 177/154///64/57//103), show no gain in length over 7 but average larger and the number of locules is increased.

"Magnerosa" has been united with 177/154 as shown in group 9 where the size and interior of the fruits and form of cluster indicate that the "Currant" still exerts a strong influence.

The "Baby Ponderosa" type of fruit (1/5//177/103) is pictured at 10 and is of marketable size; it is considered elsewhere. A plum-shaped fruit is also obtained from this cross and a specimen is shown in the group.

TOMATO NOVELTIES IN 1908.

No. 228. *"Aristobright."* The plant is a dwarf, upright, fine leaf with yellowish foliage, late in bearing with fruit changing from greenish yellow to red in ripening.

No. 229. *"Bonny Best Early."* This variety is a fine-leaved standard plant with red fruits of "Ponderosa" size but smooth. A sort which promises to be good for canning.

No. 230. *"Burbank's Preserving."* This variety is a fine-leaved, compact dwarf with red, cherry-like fruits.

No. 231. *"Coreless."* This novelty produces a thrifty, standard, fine-leaved plant, medium late, bearing a good supply of medium large, red, long "apple" fruits with good interior. It is a promising sort.

No. 232. *"The Don."* This is a standard, fine leaved variety, medium early, giving red, "apple"-shaped fruits of fair size.

No. 233. *"Earlibell."* The plants of this standard, fine-leaved variety are early bearers but produce irregular fruits.

No. 234. *"Giant Purple."* The plants were thrifty with foliage between a fine and a coarse leaf. The smooth purple fruits ripen early but are not abundant.

No. 235. *"Golden Gage."* This variety, a standard, fine leaf, is medium late, bearing good-sized, bright yellow fruits resembling those of "Golden Queen."

No. 236. *"Marvelosa."* A station novelty resulting from combining the "Marvel" and "Ponderosa," which is fine-leaved and thrifty, bearing smooth, round, red fruits.

No. 237. *"Sutton's Gold Mine."* This is a medium early, standard, fine-leaved kind, yielding fair-sized round, pink fruits.

No. 238. *"Japanese Tree."* The plants are a compact, coarse leaf dwarf, late in bearing with red, irregular fruits of medium size and not prolific.

No. 239. *"Magnum Bonum."* This standard, fine-leaved variety is an early bearer of irregular fruits.

No. 240. *"New Wonderful."* Failed.

No. 241. *"Pink Skin."* Failed.

No. 242. *"Scarlet Skin."* The plants are standard, fine-leaved early bearers but produce irregular fruits.

No. 243. *"Triumph."* This is a standard, fine-leaved sort and a medium early bearer of many good-sized, flat, irregular red fruits.

No. 244. *"Queen City."* Failed.

HAIRS OF TOMATOES.

Work toward the removal of the hairs of tomatoes is progressing. These hairs are of two general types, namely, the long pointed kind that is quite showy and gives the young parts in particular of both stem and leaf a decidedly fuzzy appearance. This form of slender hair is generally present upon the ordinary tomatoes from the time the seedling is three weeks old until the end of the life of the plant but disappears quite largely from the older portions. On the other hand, the "Currant" tomato is quite free from this form of hair and, on this account, the plants of this species are smooth in contrast with the hairiness of the ordinary kinds of tomatoes.

By breeding the two above species together, the results obtained show a reduction of the hairiness of the hybrids and the hope is entertained that a marketable size of fruit may be finally obtained with plants that are smooth. Plate X shows portions of these hairy stems alternating with those that are comparatively smooth.

The chief feature of the study of hairs is in connection with a second form of outgrowth from the stems and leaves that, from their nature, are known as glandular hairs. This kind of hair is short and low set and not easily seen without a hand-lens and the tip of each is expanded into a knob from which exudes a disagreeable thick liquid that stains the hands and clothing and is the source of the rank smell that is characteristic of the tomato foliage. This form of hair is also much less abundant upon the "Currant" than the ordinary kind and, by the breeding abovenamed, it is hoped to get plants that, with other qualities not reduced, may possess the much desired addition of freedom from the hairs in question.

While the hope is entertained of removing all the spines from the eggplant, and particularly the calyx, where they are a nuisance to all who handle the fruits, in like manner the work of obtaining glandless tomato plants is to be pursued along both the avenue of breeding and of selection. To be able to go among the tomato plants, even when moist from rain or dew, and not get smeared with the ill-smelling glandular exudation is a condition of this highly esteemed vegetable fruit that will be much appreciated.

THE TOMATO FLOWER CLUSTER.

In the flower cluster of the tomatoes, there is a great range of variation, the extremes being the simple raceme with the flowers, and afterwards the fruits, arranged alternately upon the right and left of a single axis. This is illustrated at 2 in Plate XI, where in the lower portion of the inflorescence the small fruits are shown and nearer the tip the flowers and flower buds are disposed in the same manner. The "Currant" tomato is of this racemose type, the cluster of fruits resembling quite closely that of the currant proper, from which fruit the common name for the type of tomato in question might have been given.

The opposite extreme is met with in many of the large-fruited sorts, as the "Ponderosa," and falls into the class of flower clus-

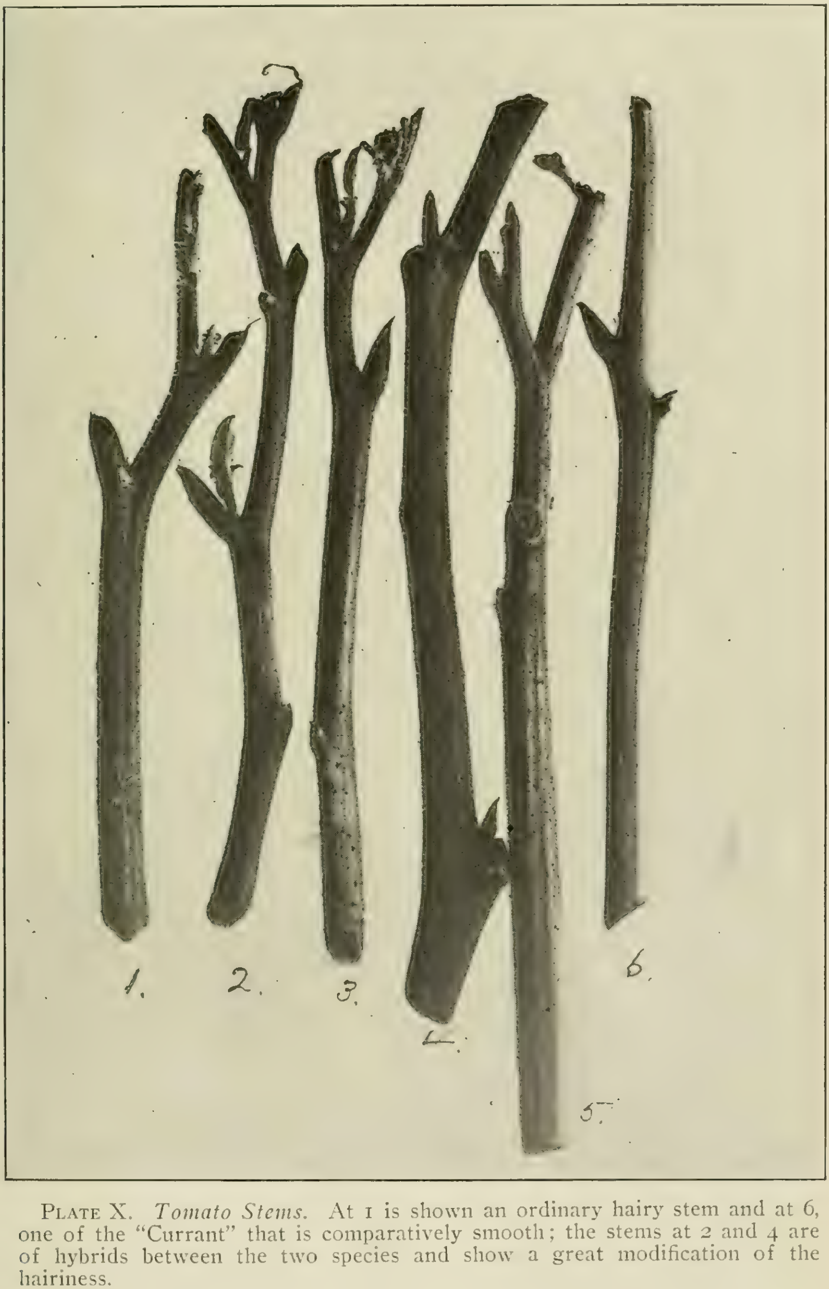

PLATE X. *Tomato Stems.* At 1 is shown an ordinary hairy stem and at 6, one of the "Currant" that is comparatively smooth; the stems at 2 and 4 are of hybrids between the two species and show a great modification of the hairiness.

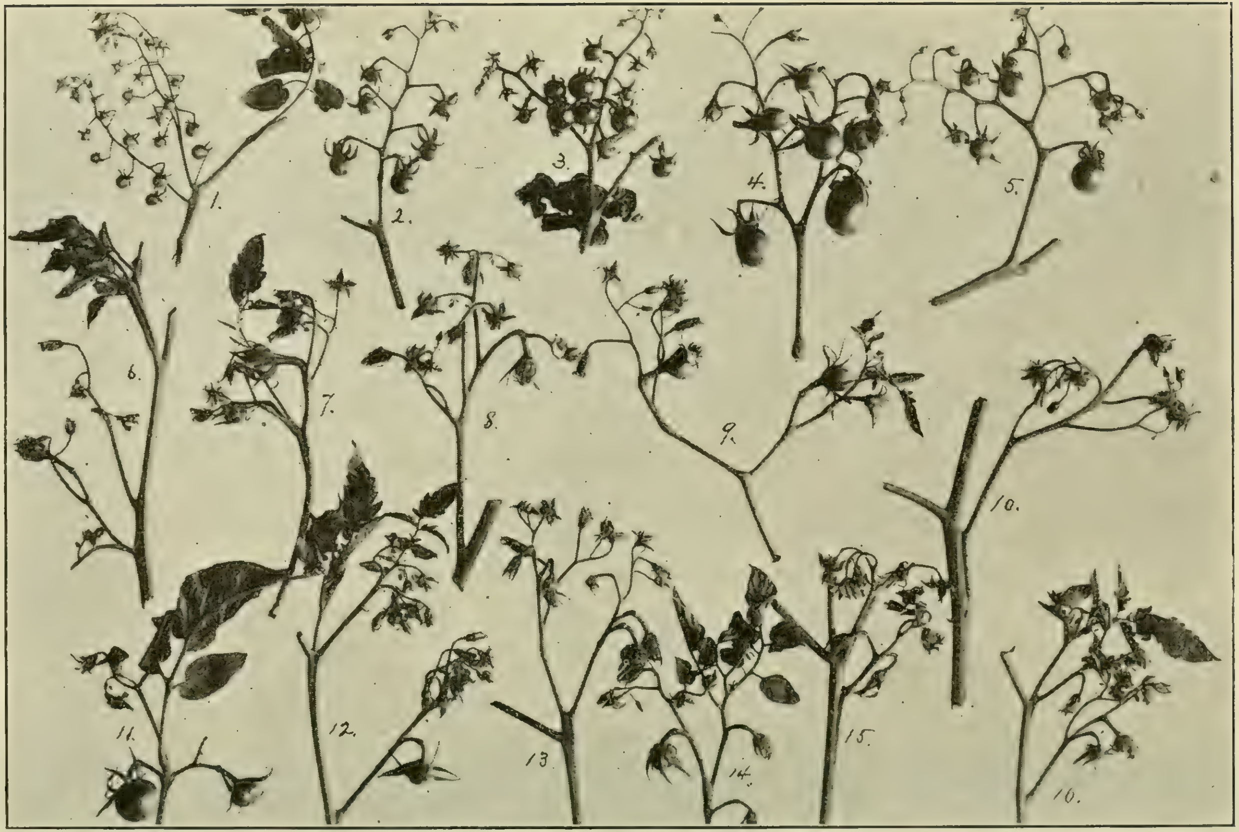
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PLATE XI. *Tomato Flower Clusters.* Some of the variations in the tomato fruit stalks are shown from 1 to 16.

ters known to the botanists as the "panicle," where instead of one axis there are two or more, as shown at 5, 8 and 13.

In the breeding together of a variety with a raceme and one with a panicle, there arise all intergrades. Thus at 1 is shown the confusion that is met with in a cross showing strongly the "Currant" blood. Here two clusters are nearly united at the base, and the upper one—with a single fruit close to its base—is forked a short distance from the point where it leaves the main stem.

In the dwarfs, the compactness that characterizes the stems and foliage is also present in the flower cluster; this is shown at 3 where a "half-blood" of "Currant" is given with its forked, thick set branch of fruits and a basal branch with but a single tomato.

A much more open cluster is shown at 4 where a long plum-fruited cross is shown in striking contrast with the previous one.

Perhaps of as much interest to the breeder are the mingled clusters that arise, namely, those in which leaves form upon some of the branches where fruits might otherwise appear. At 14, for example, the cluster is made up quite largely of foliage; the upper cluster in 12 ends in a well-formed leaf and at 11 the large "potato" leaf is intimately associated with the fruits. At 7, the seemingly central flower is much larger than any others and it is difficult to make out clearly the relation of flower and foliage structures.

As a rule, the flower clusters are quite regularly disposed upon the upper side of the naturally inclined stem and arise some inches below every third leaf. At 6, 12 and 16 are shown instances where two clusters are near each other. Occasionally the stem of the flower cluster is fused with the main branch for some distance as shown at 10 and 15.

THE TOMATO CALYX.

Some observations have been made upon the tomato calyx. As might be expected, all of the simpler forms of fruits, that is, the nearest to the wild state, and having but two seed-cavities, as a rule show only five lobes to the calyx and these are generally long and slender. The number of stamens in such flowers agrees closely with that of the calyx "teeth" and the same is true of the lobes of the corolla. In other words, the number five prevails in all parts of the flower excepting the pistil (fruit) where it is reduced to two, a fact that obtains generally in the many other species of the large family to which the tomato belongs.

A study of the larger-fruited cultivated sorts shows that the calyx is quite variable in the number of lobes to the calyx and their size, shape and arrangement; six "teeth" are very frequently met with in the garden sorts of the smooth or "apple" type of fruit but these six may be long and slender or broad and blunt, two or three may be blended at the base thus giving a very irregular appearance to the whole calyx.

In the broad flat fruits, having many seed-cavities, the calyx teeth are often double those in the simple fruits of the "plum" or "pear" types. In these instances, all four sets of floral organs have undergone an increase of number and from the two remaining, namely, the calyx teeth and the seed cavities, the number of stamens and lobes to the corolla can be inferred with some degree of accuracy. In like manner, a glance at a corolla when the flower is in bloom gives an indication of the internal structure of the fruit that is to develop therefrom.

The length of the calyx "teeth" is in some degree correlated with the length of the fruit, that is, a long slender calyx is associated with the "pear" and "plum" types of fruit and short, broad lobes are an index of a flat fruit. In the case of the "pear," the long slender neck of the fruit accentuates to the eye the size of the calyx.

There is likewise some relation between the length of the plant and that of the calyx for all dwarfs, so far as studied, have a broad, short-toothed calyx, while the very long-growing "Currant" has a calyx that is large and out of ordinary ratio to the other parts of the fruit; in this respect, not correlating with the length of the fruit. The short calyx among dwarfs is to be expected where all parts are abbreviated as, for example, the fruit stem to which the calyx is attached.

EXPERIMENTS WITH EGGPLANTS.

The commercial varieties of eggplants were quite generally represented upon the experiment grounds, to which the following three novelties were added this season:

31. *"New Tree, or Upright."* This variety resembles the "Florida High Bush" and is a good bearer of late, purple, bell-shaped fruits that do not keep well.

32. *"Purple Tokio."* This sort is so close to the "Black Pekin" as not to be easily distinguished from it, but it seems larger in plant and less productive.

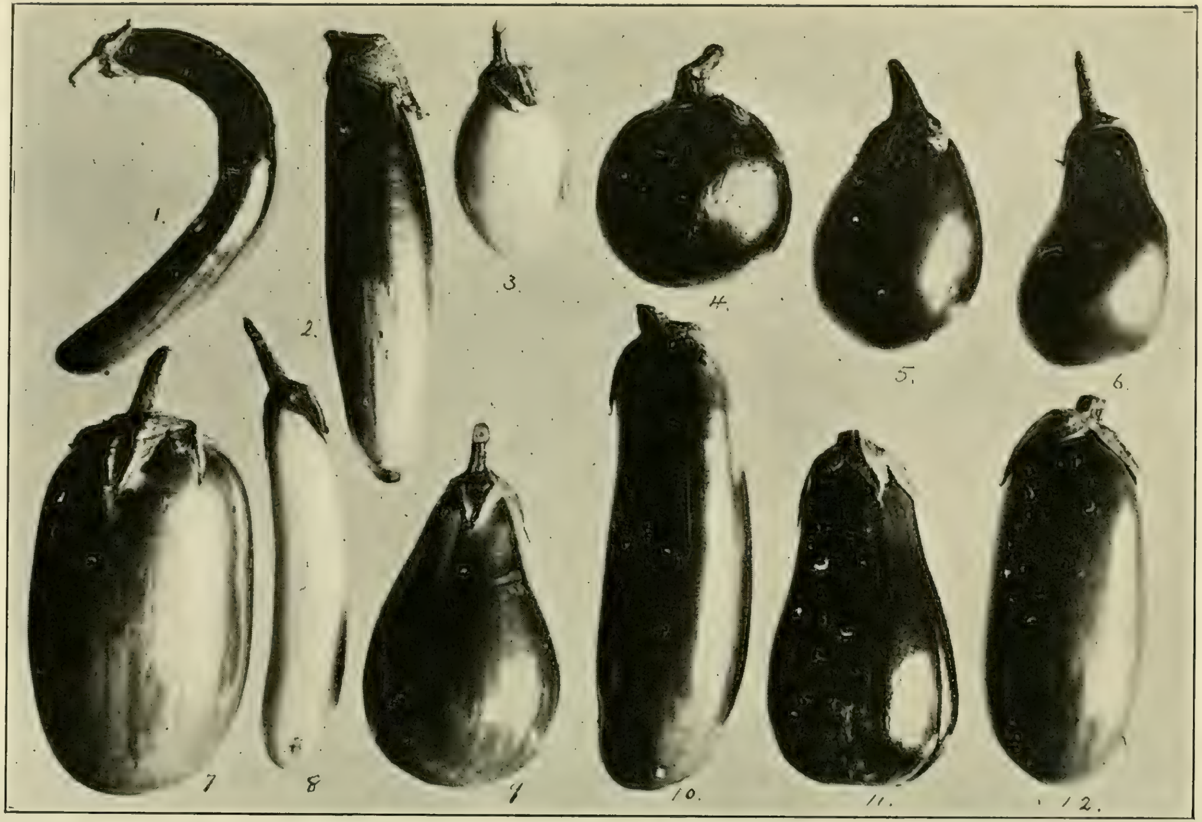

Plate XII. *Eggplant Crosses.* At 2 is a cross between "Black Snake," shown at 1, and "Round White," at 3; at 5, cross between "Black Pekin," 4, and "Dwarf Purple," 6; at 7, between "Black Pekin," 4, and "Long White," 8; at 9 between "Dwarf Purple," 6, and "Longfellow," 10; at 12 between "Jersey Belle," 11, and "Round White," 3.

33. *"Northmount."* This and the "Black Beauty" are nearly the same and, therefore, it bears large, handsome fruits that are apt to rot.

SOME OF THE NEW CROSSES.

A long list of crosses and hybrids occupied the larger part of three plots and by means of irrigation fair results were obtained in spite of the dry, hot weather.

Plate XII shows some of the crosses of last season as their fruits appear in the blend of the present year. One of the late introductions to the breeding grounds is the "Round White" (29), a variety with plants of medium size and small fruits of oval shape and a firm skin and flesh, the latter qualities making it a good keeper and apparently of great value as a breeder.

The first cross (2/29) is shown at 2 with the male parent ("Black Snake") upon the left and the mother ("Round White") upon the right. The reader will please bear in mind that the number assigned to the fruits in the plate has no direct relation to the record numbers of the parents, or those of the crosses. The cross produces a thrifty plant bearing a large crop of long, nearly straight fruits that are larger than either parent and of a desirable shape for culinary purposes. The white of the mother is seen in the flesh and upon the outside, the purple of the "Black Snake" is much reduced, particuarly at the free end which is somewhat striped with pink and white.

At 5 is shown a cross (3/5) between the "Black Pekin" shown at 4 and the "Dwarf Purple" seen at 6. Here both parents are of the purple group of eggplants and the cross naturally shows the same dark color and its absence under the close-fitting calyx lobes. In shape, the fruit of the cross is near to the "Dwarf Purple," and in size of plant it is larger than the dwarf mother and much smaller than the high "Pekin." So far as results may be predicted from the first year, this cross will be an improvement upon both parents in size of plant and fruit and its good-keeping quality is well assured.

At 7 is shown a fruit of a cross (3/11) between the "Black Pekin" and the "Long White," that is, between parents producing fruits like the one shown at 4 and 8 respectively. This cross is of special interest in that it is of much more economic value than either parent, for the "Pekin" is a poor bearer of round fruits that are quite apt to split before reaching table maturity and the "Long White" is too slender to be popular. It will be seen that the cross is an eliptical fruit of sufficient size and, furthermore, the plants are far more productive than either parent.

The fruit shown at 9 is of a cross between "Dwarf Purple" and a previous cross—"New York Improved" upon "Black Snake" (18/2)---that is, Station Eggplant No. 1, and bearing the name of "Longfellow" upon the breeding grounds, a specimen of which fruit is shown at 10. The cross in question has, therefore, a half of the "Dwarf Purple" and a quarter each of the "Black Snake" and "New York Improved." This gives a medium-sized plant with a good supply of pear-shaped fruits strongly marked with the peculiar purple of two parents. It is a very good keeper and possibly will make a desirable cross for the grower for the early market.

At 12 is a specimen of a fruit borne by a plant (10/29) resulting from breeding the "Jersey Belle," a poor specimen of which is shown at 11, and the "Round White" shown at 3. The nine plant averaged eleven fruits, of fine, oval shape with a flesh of most desirable texture and color and excellent keepers, the last-named quality being due to the influence of the white-fruited mother.

Plate XIII shows several additional crosses in the blend condition but here three varieties are brought together, that is, a previous cross is combined with some variety either as the male or female parent. A cross of the "Black Snake" upon "Dwarf Purple" was last year worked upon the "Round White" (2/5//29), of which thirteen plants were grown the present season, all tall, purplish and produced long fruits, as shown in the engraving, with a mixture of greenish stripes upon a purple background. The fruits were remarkable for their good keeping quality and, being produced in large numbers, makes this cross one of much promise.

At 2 is a combination of "Pekin" upon "Black Snake" upon "Dwarf Purple" (3/2//6), which gave medium-sized, purple plants with dark fruits approaching the "Pekin" in the round shape.

No. 3 is a cross of "Jersey Belle" upon the combination of "Black Snake" with "Dwarf Purple" (10///2/5). The plants are medium tall and produce long, curved, purple fruits that are of fair size and desirable shape.

At 4 is a specimen fruit of the "Jersey Belle" upon the cross of "Pekin" with "Black Snake" (10//3/2) which has proved satisfactory in many respects.

The fruit at 5 is from a plant resulting from a cross of the "Jersey Belle" upon the "Dwarf Oval" with "New York Improved" (10//6/19). The plants were productive and the fruits large and somewhat angular.

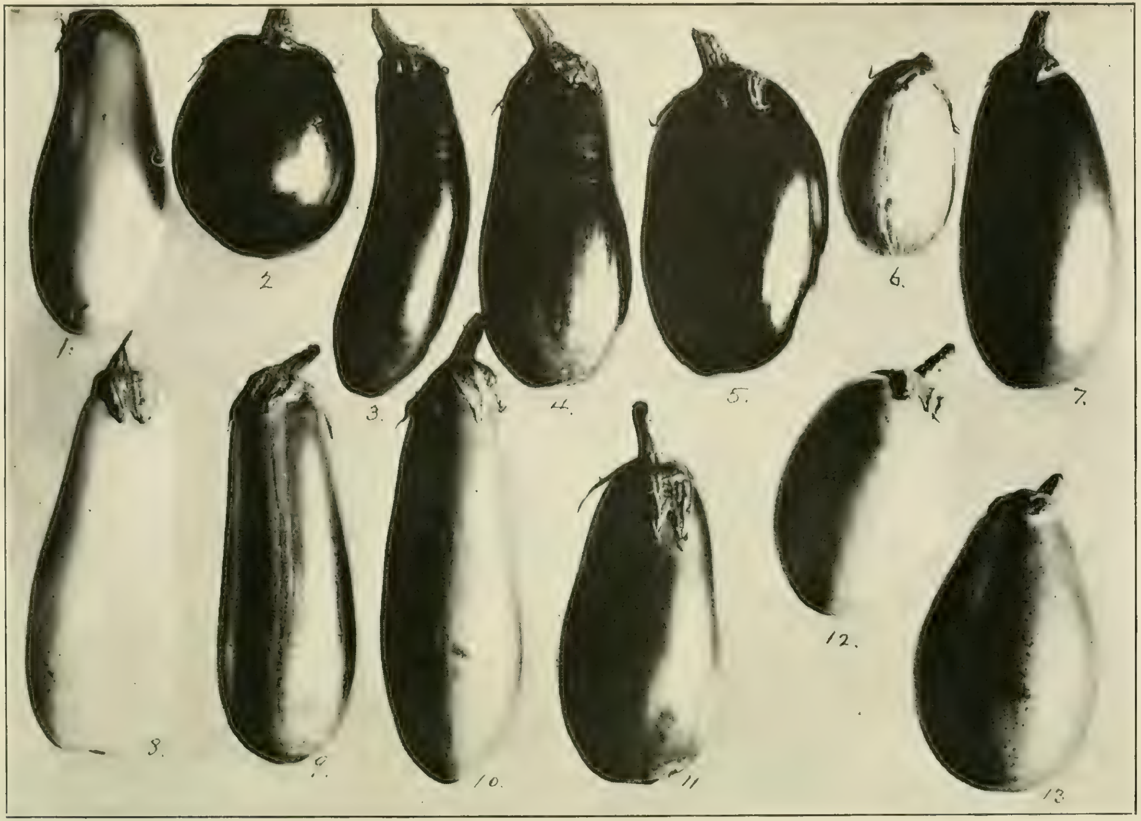
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PLATE XIII. *Eggplant Crosses* with three varieties involved.

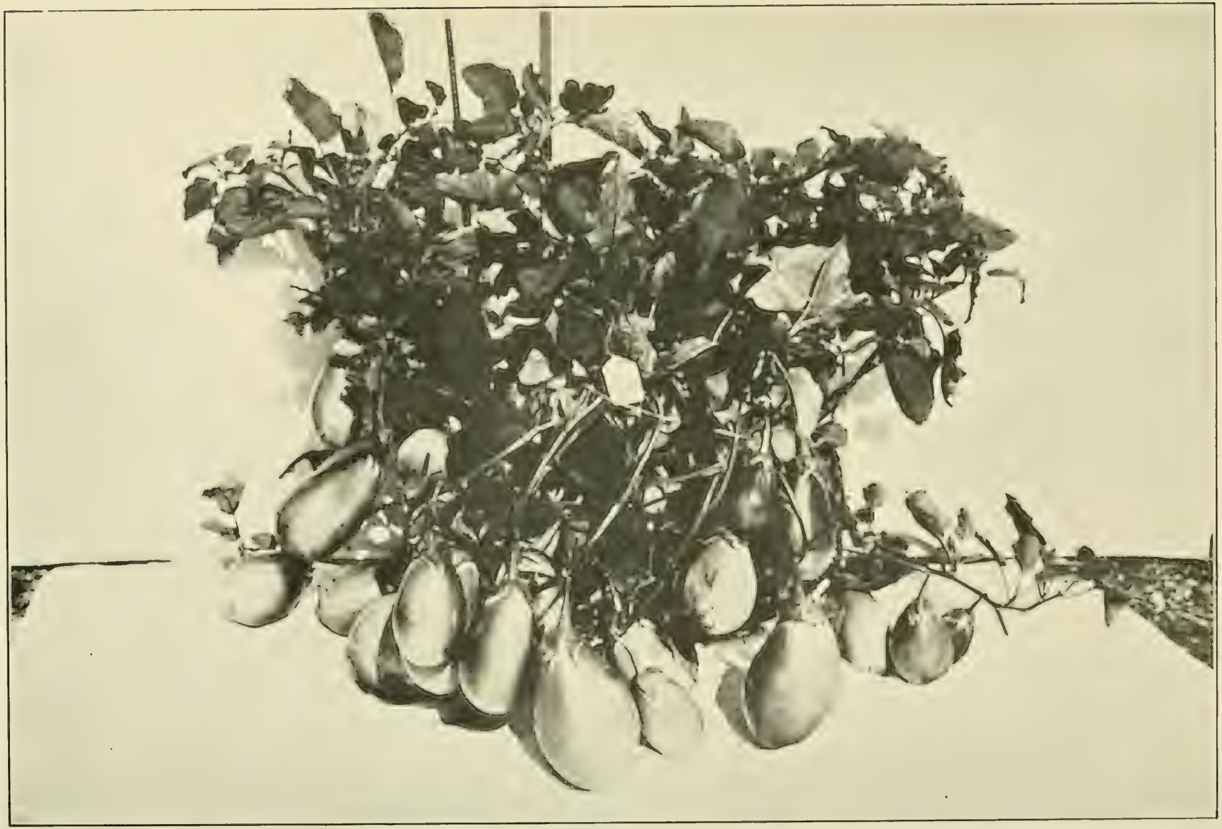

PLATE XIV. *Eggplant Cross.* A plant of the "Round White" upon the "Dwarf Purple-New York Improved," showing the large yield of handsome fruits.

At 7 is a combination of the "Striped" (shown at 6) upon a cross of "Dwarf Oval" upon "New York Improved" (21///6/19). The plants were medium, purple and productive, the fruits being of a handsome, long oval and of a solid purple color without sign of the stripes of the parent.

The fruit at 9 is a cross of the "Ivory" (shown at 8) upon the "Black Snake" with the "Dwarf Purple" (26///2/5). The fruit shape is long like the "Ivory" but has the purple color dominant. It is a good keeper.

At 10 is shown a fruit of the cross of the "Ivory" upon "Black Snake-New York Improved" (26//2/18). This is somewhat different in shape from the last and has less purple in the stem and foliage.

The fruit at 11 is a combination of the "Jersey Pink" upon the "Jersey Belle-Dwarf Purple" cross (28//10/5), which has produced a set of small plants that bore a good crop of fair-sized fruits.

In the next double cross (12), the "Round White" is bred upon the "Black Snake-Dwarf Purple" (29//2/5) with the result that a solid, short, oval fruit is obtained in considerable numbers.

The last fruit shown (13) also has the "Round White" as the pollinator upon the "Dwarf Purple-New York Improved" cross (29//5/18). As seen, a fine pear-shaped fruit has resulted with a firm skin and white flesh. This combination brings together three widely different kinds of eggplants. Taking up the parents in the order in which the double cross was developed, the "Dwarf Purple," which as its name indicates is a low-growing type with the purple color everywhere abounding, in leaf, stem and smallish pear-shaped fruit, was bred upon the "New York Improved," which is one of the most generally grown of the large-fruited sorts. As a result of this cross, strong, moderately low-growing plants were secured that produced good-sized fruits of a shape between the "pear" and "oval" types.

Upon the above was brought, as the pollinator, the "Round White," which is easily recognized by the small white oval fruits, borne upon plants of medium size. Plate XIV shows a sample plant of the result of the double cross and from it may be truthfully gathered, first of all, that the combination is very prolific; there are fully twenty fruits of marketable size but none of them approaching the great "eggs" that are borne often singly by some of the commercial sorts. The color of the fruit is a shade of lilac, more or less mottled, and in this respect is quite unusual and at first sight might not satisfy the old standard of a deep purple that has been in vogue for long. The time is fast approaching when one color for eggplant fruits will be a memory only, a green, lilac, pink and white will be associated with the purple upon the market stands as proper qualifications for public favor in eggplants. At that time, not far away, this vegetable will have gained its rightful place in the esteem of all.

The fruits under consideration are interesting in not showing under the calyx any of the little color that still remains—a characteristic that comes from the "Dwarf Oval" parent and is evident in the engraving, in which a line of white is shown around the calyx where the coloration due to exposure to the sun does not keep pace with the elongation of the fruit.

TABLE OF EGGPLANT CROSSES.

Record Number of Cross.	Plant Color.	Plants, Standard.	Plants, Medium.	Plants, Dwarf.	Fruit Color.	Average. Number of Fruits per Plant.
2/5//29	Purplish.	....	14	....	Purple and green	23
2-29	Light purple	2	2	....	Purple and green	22
3//2/6	Purplish.	....	2	1	Purple.	7
3-11	"	7	....	....	Purple and green	11
5-27	"	....	....	3	Purple.	14
10//2/5	"	5	....	....	"	19
10//3/2	"	....	5	....	"	14
10//6/19	"	....	10	....	"	13
10-29	"	....	9	....	"	11
11-3	"	4	....	....	"	11
21//5/2	"	....	2	....	"	21
21//6/19	"	....	12	....	"	13
26 2-5	"	....	4	....	"	10
26//2/18	Green.	1	3	....	"	15
26//10/2	"	....	7	....	"	14
27-29	"	....	5	....	Green and purple.	12
28//10/6	Purplish.	....	3	....	Purple.	13
28-29	Green	....	4	....	White and striped	8
29//2/6	"	....	4	....	Light purple	12
29//5/19	Purplish	1	6	....	Purplish,	12
2-6 II	"	....	1	3	Purple.	16
2-18 I	"	2	7	....	Purple.	12
2-5 II	"	....	2	2	"	15
2-5 II	"	1	....	3	"	23
3-2 I	"	....	2	2	"	15
3-5 II	"	1	3	....	"	12
6-19 I	Purple and green	....	1	4	"	15
10-17	Purplish	1	....	....	"	14
11-2	Purple and green	3	2	....	Purple and greenish white	9
11-4	Purple and green	....	4	....	Greenish white	9

REPORTS FROM TESTERS OF "IVORY" EGGPLANT."

(1) "This is a very rapid grower; the plant is green in color with snowy white fruit, which is long in shape, of good size and a good bearer." (2) "Very proroutive and of excellent size." (3) "The plants were set out late

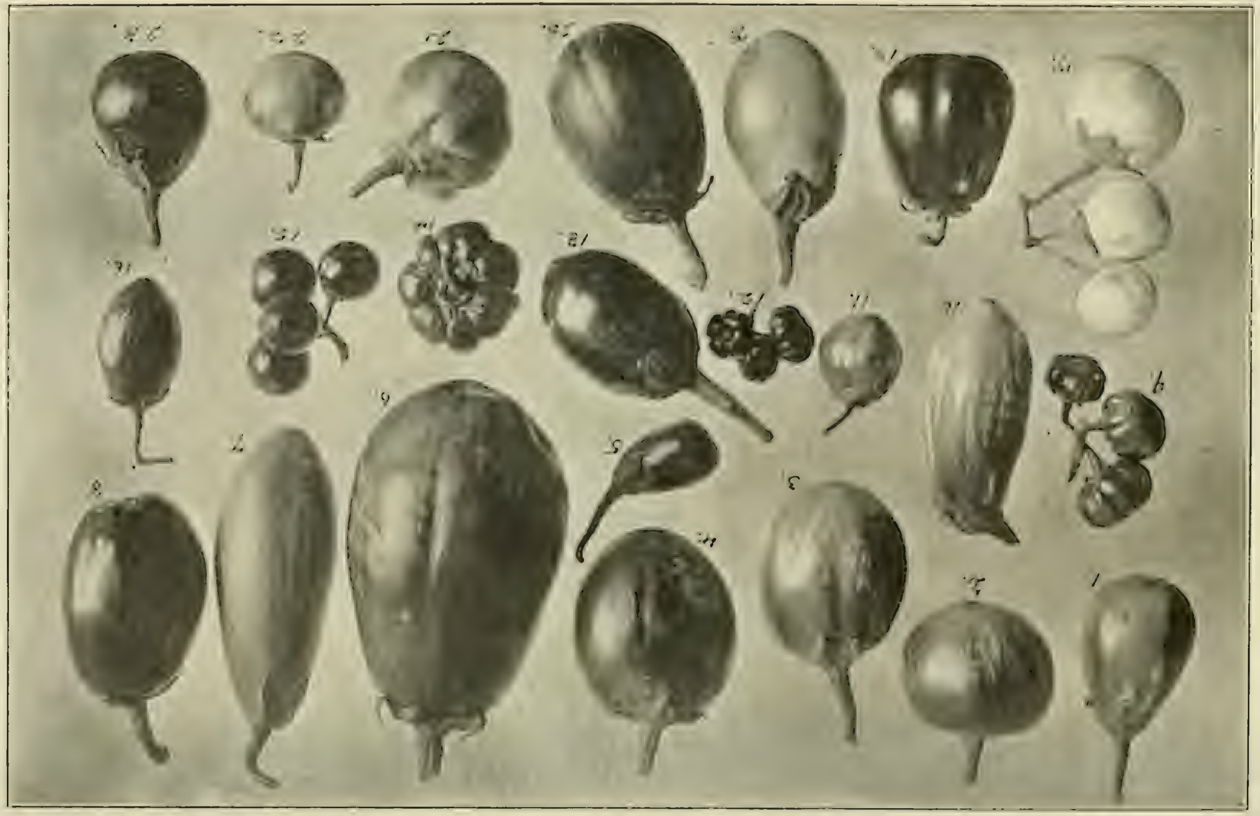

PLATE XV. *Hybrid Eggplants.* Twenty-three selections from the "American-Chinese" fruits are here shown.

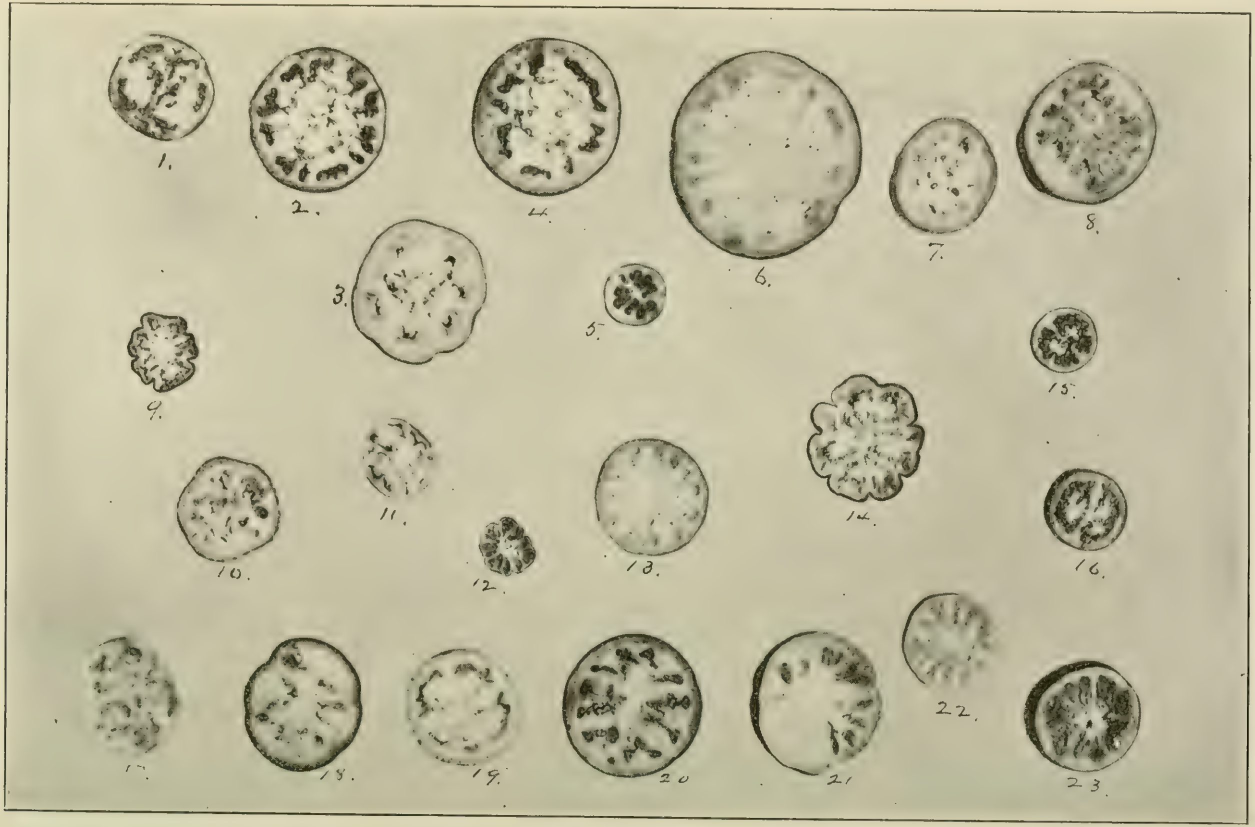
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PLATE XVI. *Hybrid Eggplants.* This plate shows sections of the same fruits given in Plate XV and in same order and positi

but made a vigorous growth. The first fruit ripened about August 25th. The color is mostly white, streaked with purple. The plants now, September 9th, are full of fruit which is growing very rapidly and I consider the plants very productive as they are simply loaded. The plants are strong, holding fruit well off the ground as a rule. The flavor was pronounced fine by all who have tasted the fruits." (4) "The 'Ivory' Eggplant is very prolific, of good size and most desirable for table use." (5) "The fruit is long and I like the shape." (6) "The eggplant was quite productive, with fruits very uniform in size and shape." (7) "The fruit is small but attractive looking, rather elongated." (8) "The plant is very vigorous and prolific; the fruit is of large size, the average length ten inches, and the color is almost white. When cooked, the fruit is of good flavor. The size is uniform and the average number of fruits on a bush is twelve." (9) "There were lots of fruit; I like them very much." (10) "This eggplant is all right for size, vigor and productiveness and is as good as the old varieties. One plant yielded purple fruit. The balance were a beautiful ivory. The shape of the fruit was uniform and more oblong than the ordinary varieties." (11) "I have never seen a more attractive looking fruit; it is of long pear shape." (12) "I am highly delighted with this eggplant; it was very productive and the fruit was pure white."

REPORTS FROM TESTERS OF "JERSEY PINK" EGGPLANT.

(1) "This eggplant was very prolific; the fruits were of good size, fine color and excellent flavor." (2) "This variety grows rank and over two feet in height and is an abundant bearer. The shape of the fruit is perfect." (3) "The eggplants were round, pink, large, and strong. They were very good and I have some of them yet, Sept. 14th." (4) "The plants were stocky and absolutely free from blight. The fruits were purple, rather than pink, few in number but of good quality." (5) "These eggplants were very good, of large size, good color and uniform." (6) "The plants stand from eighteen to twenty inches high and are very strong and healthy. There are from two to eight fruits on a plant." (7) "All the eggplants are of fine quality. The flesh of the pink is very superior to the black." (8) "The 'Jersey Pink' is a very vigorous plant, growing three to four feet in height and is a good bearer". (9) "This is a large plant and a vigorous grower. The fruit is pink and of good flavor." (10) "The plant was very thrifty and healthy. Quality of the best." (11) "All the plants of this variety bore extremely well."

A STUDY OF HYBRID EGGPLANT FRUITS.

From the two hundred and four hybrid eggplants grown to full fruitage the present season, a selection has been made of some of the more evident types of fruits which have been brought together in Plates XV and XVI. The specimens are arranged arbitrarily according to the numerator of the fraction expressing the combination, beginning with the lowest:

No. 1. This is the "Early Dwarf Oval" bred upon the hybrid of "Scarlet Chinese" upon "Early Dwarf Oval" (6//25/6) and therefore has three-quarters of the latter to one-quarter of the "Chinese" blood. The sample fruit resembles in shape the "Dwarf Oval" and shows clearly one character of this variety, namely, the absence of color under the calyx. The lower half of the plate consists of the sectional views of these same fruits arranged in practically the same order. The lower half of the plate consists of the sectional views of these same fruits arranged in practically the same order. The egg-shaped fruit is quite seedy and the seed arrangement shows a bilateral symetry that has its points of interest when a study is made of the placentae of the eggplant fruits.

No. 2. This is a combination of two hybrids, namely, the "Jersey Belle-Dwarf Oval" cross bred as the pollinator upon the "Fordhook" upon "Scarlet Chinese," expressed in record numbers as follows, 10/6///14/25. Here, there is three-quarters of "American" blood, representing three varieties, upon the "Chinese" species and yet the qualities of the latter are quite in evidence. In shape and size, and even in interior structure, there seems to be enough to lead one to suspect that it is at least a "half-breed," were not the voice of experience strongly against it. The "Chinese" has a remarkable power to draw the cultivated "American" types to itself.

No. 3. This is a specimen from another plant of the same double breeding as No. 2, in which the longitudinal axis is much extended and the calyx, for example, is nearer to the "American" size. It was nearly seedless as the slice shows.

No. 4. Here is another of the above combination from a third plant which, in shape and smoothness (a nearly perfect oval), and color are enough different from the others to appear distinct. The internal structure is decidedly of the "Chinese" type.

No. 5. Here the fruits of the plant were all small, long and bell-shaped; calyx large and the color yellow when mature. The internal structure is seen to approach the "Chinese."

No. 6. This fruit is the largest of the set and represents the extreme range of the combination of the last four fruits; in other words, fruits 2 to 6 inclusive are all of the same blood and show a wide range of variation. This No. 6 is a fruit of marketable size and acceptable in shape, color and texture of flesh; in short, it is so close to the "American" in general appearance that it would easily pass among the ordinary commercial sorts of eggplants. The skin of the fruit is much more resistant than that of the "American" and it has a good shape and the firm flesh contains but few seeds. The only objection to it is a slight bitterness when served upon the table, not enough to cause its being rejected and possibly this may be removed by treatment with vinegar before cooking, as is the practice with some housewives with the ordinary eggplants. The plant is strong and well loaded with the fruits as shown in Plate XVII. The fruits keep

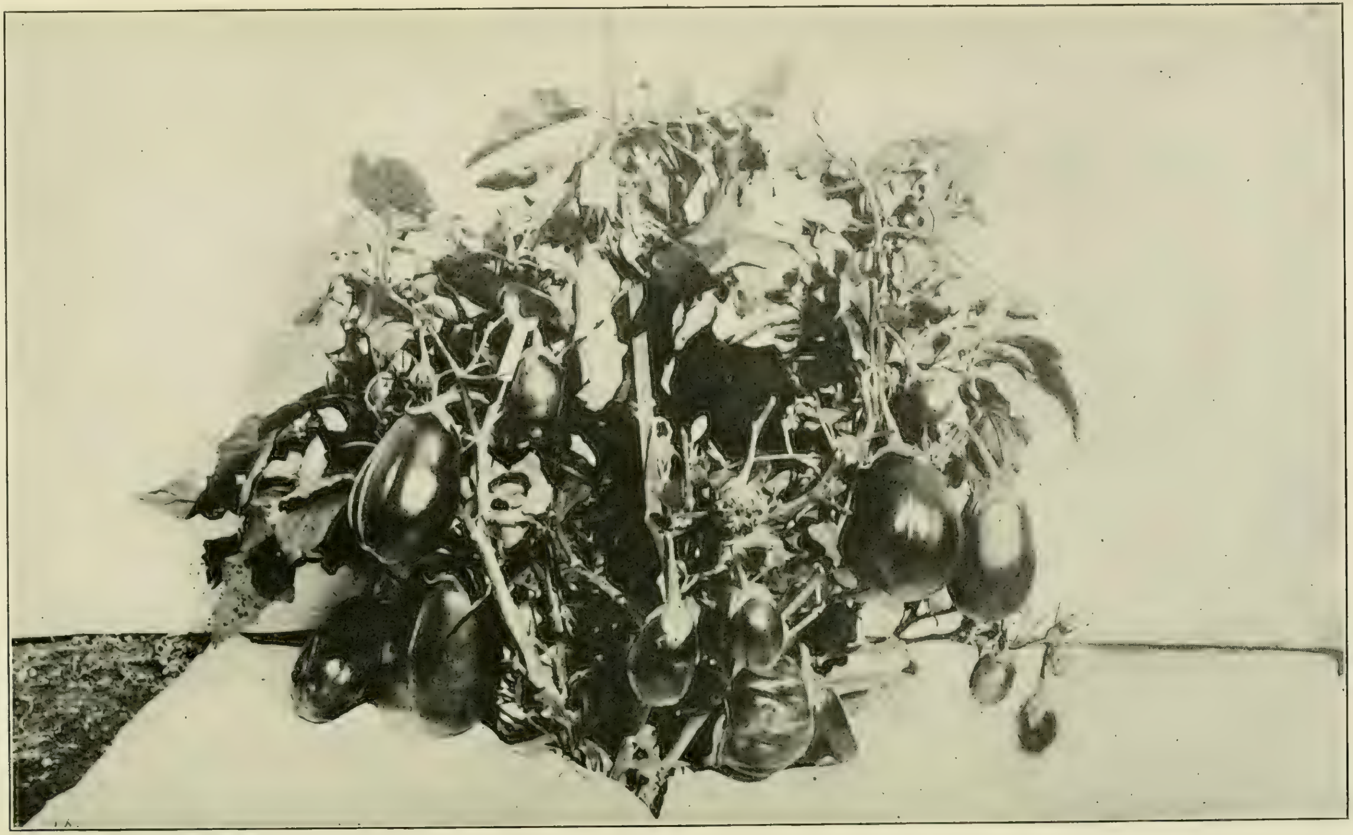

Plate XVII. *Hybrid Eggplants.* A choice plant of the combination of "Jersey Belle-Dwarf Oval" upon "Fordhook-Scarlet Chinese." The fruits are of marketable size and shape.

well and there is much promise of securing further improvement by breeding. The plant is spineless.

No. 7. This long fruit is a combination of "Jersey Belle" upon the "Fordhook-Chinese" (10///14/25) and therefore is a three-quarters blood "American." It is, perhaps, as desirable in every way as the preceding one although lacking in size, because long fruits are better adapted for culinary purposes. The section (7) shows more seediness than the last but in this respect it is ahead of many of the "American" sorts.

No. 8. This is a representative of the last combination, in which the oval shape is well shown, but the interior is faulty in having much of the openness of the "Chinese" fruit.

No. 9. This brings the reader to a kind of fruit borne usually in clusters that is the direct result of the breeding of the "American" upon the "Chinese" (14/25). The slice (9) exhibits the corrugations of the exterior and the five somewhat double seed-cavities with much vacant space around the seeds.

No. 10. An extreme form of the last-named hybrid is here shown, a long fruit approaching the "American" parent ("Fordhook") in appearance and interior structure. Here, as in many others of the hybrids, the exterior color is striped, particularly at the free end.

No. 11. In this small, apple-shaped fruit is the blood of the "Chinese" upon the "Dwarf Purple" (25/6), in which case the union is reversed and the "American" species becomes the mother. In texture, the fruit is nearly ideal and it seems possible by further infusion of "American" blood to obtain a variety of high market value.

No. 12. Quite different from the last, but of the same combination, are the fruits shown in a cluster at 12. In every way they are a close representative of the pure "Chinese" in orange color, flat and corrugated shape and large and numerous seed cavities.

No. 13. This, with the last two, all of which are the same union, furnishes a fine example of the variations that may take place when two species as widely diverse as these here involved are bred together. The color, size and shape of the fruit place it among the "American" and it is only when the skin and interior are studied that the combination becomes apparent. There are many greenish, pulpy seed cavities arranged in a circle not far from the thick skin that are evident and bear a bitter principle derived from the "Chinese" parent that renders the fruit unfit for the table.

No. 14. This and the two following are variations in the same combination, in which the "Chinese" makes up three-fourths of the blood according to the following fractional formula 25//14/25, with "Fordhook" as the male parent in the first union, upon which hybrid the "Chinese" was again bred. The fruit represented is a flat, orange, corrugated specimen closely adhering to the "Chinese" type, judged both from the exterior and within, as shown at 14 among the slices.

No. 15. From the same combination comes a plant bearing large numbers of small, smooth, shining fruits, a cluster of which is shown at 15. While in themselves commercially worthless, they show a reduction of the seed-cavities plainly to two, as seen in the slice, that relates the eggplant in this regard to the two-celled ovary present in a large number of the fruits of the order to which the parents of the hybrid in question belong.

No. 16. In some respects, particularly in the hardiness of the exterior, its smoothness and two seed-cavities, this specimen resembles the last but the fruit is much larger and long, egg-shaped.

No. 17. In this cluster of three very attractive apple-shaped fruits with a pale lilac upon a white back-ground, there is an introduction of the "Ivory" (26) in addition to the "Fordhook" of the original combination so that the formula is 26//14/25, which the reader will easily translate for himself. The interior of the fruits, of which there is an enormous number upon the plant, is as white in flesh as that of the "snow" apple and, were it not for the strong impress of the "Chinese" in large cavities and abundant seed, there would be reasonable hope of quickly developing fruit of high keeping-quality. A plant of this combination is shown in Plate XVIII.

No. 18. This fruit is one of many upon the plant having the same "blood" as the last but of a dark color and bell-shaped with ridges at the broader end. The flesh in this is good and nearly white with the seed-cavities not strongly in evidence and it may prove an acceptable subject for further breeding.

No. 19. Here the "American" and "Chinese" are equally represented under the formula 26/25//14/25, that is, the "Ivory" and the "Fordhook" are pitted against the "Chinese," the latter being bred with each and then the two hybrids combined. It is of special interest to note that the white color of the "Ivory" is dominant while the shape is largely that of the "Fordhook," and the interior has a remarkable reduction of the seed-cavities which, in general structure, conform closely to the "Chinese."

No. 20. The same combination as the last is represented here and, while the shape and size are not far different, the color is unusual in that the indifferent mingling of green and purple soon changes to a true bright orange, making these fruits with their fine shape and smooth, shining exterior the most attractive of all to the eye.

No. 21. The last three numbers of this assemblage of hybrid fruits are with the "Round White" (29) as the last introduction to the combination, the formula being 29/25//14/25 and, therefore, the "Chinese" is repeated while "Round White" and "Fordhook" appear but once. The fruits, strongly marked throughout with the white color, are flat and somewhat ribbed and with an interior showing the loose seed-cavities that characterize the "Chinese." A further introduction of the "American" blood, thus reducing the "Chinese," gives promise of the attainment of a desired end.

No. 22. In this the fruits are very numerous, much resembling those of No. 17 in surface color but more strongly lilac and the white interior less occupied with the seed-cavities. In the sectional view (22) this feature is quite evident. In this hybrid, the formula is 29//14/25, and therefore the "American" makes up three-fourths of the blood.

No. 23. This is the same as the last in its combinations but differs widely from it in the size, shape and color of the fruits, in these respects resembling the "Fordhook." The section is quite disappointing, for while it is generally upon the plan shown in 22 it is more like the "Chinese" and, therefore, less desirable.

EGGPLANT HYBRIDS.

The table below describes five plants of the "Dwarf Purple-Scarlet Chinese" hybrid (6/25) in the second generation, being the offspring of B-5 grown in 1907, which was tall and spiny with purple stem and leaves and produced seventy-one fruits.

Size.	Color.	Leaves	Spines.	Flowers.	Number of Fruits.
No. 1. . . .Dwarf. . . .	Green. . . .	Medium smooth. .	Yes.	Purple.	14
No. 2. . . .Dwarf. . . .	Green. . . .	Medium smooth. .	No.	Pale purple. . . .	11
No. 3. . . .Dwarf. . . .	Green. . . .	Medium smooth. .	No.	Pale purple. . . .	9
No. 4. . . .Dwarf. . . .	Green. . . .	Smooth.	Yes.	White.	25
No. 5. . . .Medium. .	Purple. . .	Smooth.	Yes.	Purple.	17

The next table gives six plants of the reciprocal whose mother plant, B-5, was of dwarf habit with purple stem and foliage, smooth leaves and spiny, bearing twenty-one fruits

Size.	Color.	Leaves.	Spines.	Flowers.	Number of Fruits.
No. 1....Medium tall...	Green.....	Smooth...	Yes.......	Purple........	5
No. 2....Dwarf.........	Purple....	Smooth...	No.......	Purple........	33
No. 3....Dwarf.........	Green.....	Smooth...	Yes.......	Light purple...	135
No. 4....Dwarf.........	Green.....	Smooth...	No	Light purple...	14
No. 5....Medium.......	Green.....	Smooth...	Yes.......	Light purple...	0
No. 6....Medium tall...	Green.....	Smooth...	Yes.......	Light purple...	25
No. 7....Dwarf.........	Purple....	Smooth...	Yes.......	Purple........	2
No. 8....Medium tall....	Purple....	Rough....	Yes.......	Purple........	14

The following table represents individuals of the "Fordhook-Scarlet Chinese" hybrid (14/25) in the third generation from the blend, the mother plant (B-13-4)being recorded as tall with purple stem and foliage, wrinkled leaves, and bearing nine fruits.

Size.	Color.	Leaves.	Spines.	Flowers.	Number of Fruits.
No. 1..Tall..........	Green. ..	Medium smooth..	Yes.......	Light purple.	1
No. 2..Medium tall...	Purple. .	Medium smooth..	Yes.......	Purple......	38
No. 3..Dwarf.........	Purple. .	Medium smooth..	Yes.......	Purple......	54
No. 4..Dwarf.........	Purple. .	Medium smooth..	Yes.......	Purple......	27
No. 5..Medium tall...	Purple. .	Medium smooth..	Yes.......	Purple......	72
No. 6..Medium tall...	Purple. .	Medium smooth..	Yes.......	Purple......	68
No. 7..Dwarf.........	Purple. .	Medium smooth..	Yes.......	Purple......	57
No. 8..Dwarf.........	Purple. .	Medium smooth..	Yes.......	Purple......	32

The plant, recorded as 25///14/25 (B-24-5), was of dwarf habit with a green stem and leaves, spineless and very fruitful and shown in part in Plate XV of the report for 1907. Thirteen offspring were grown this season and the following facts concerning each are recorded. The fruits produced this year resembled the parent in form but varied greatly in size.

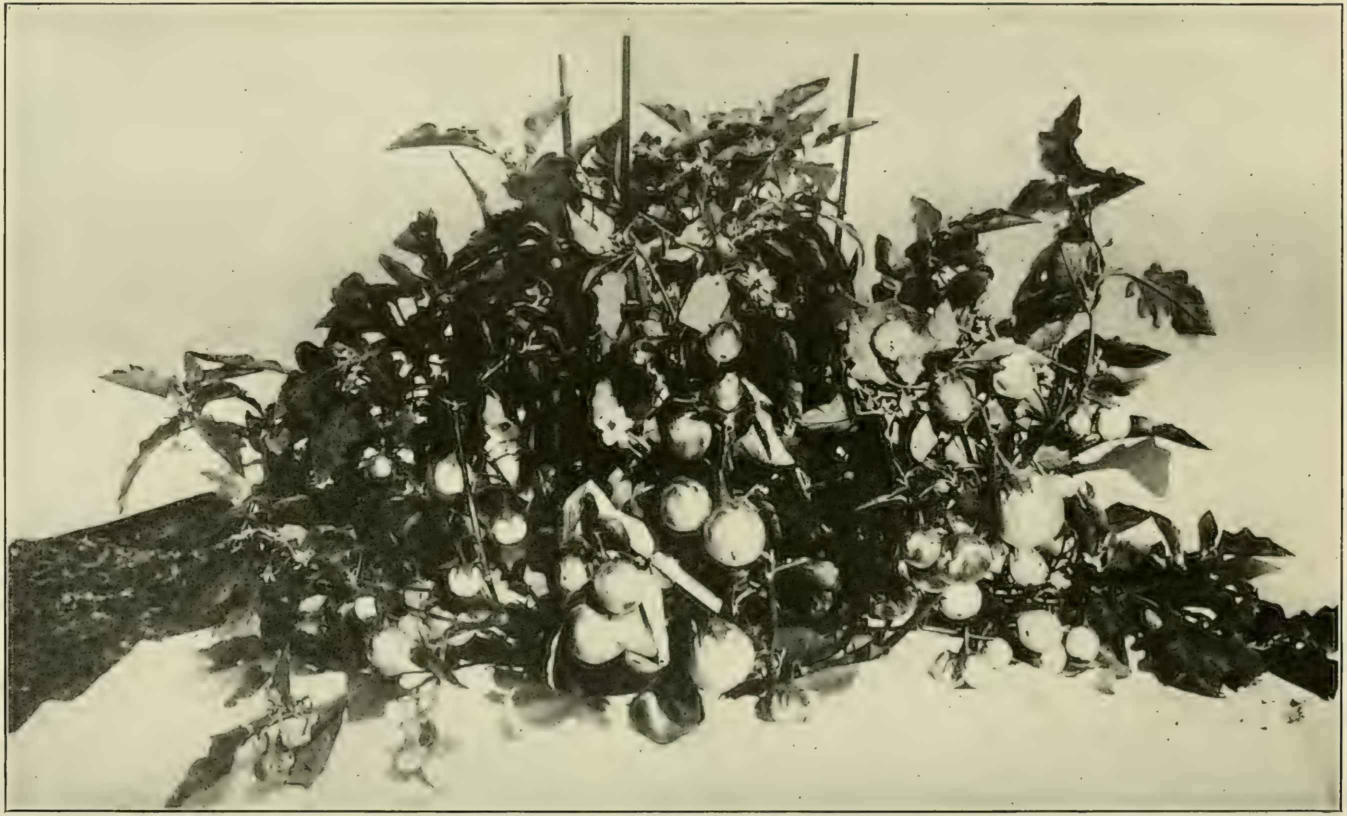

PLATE XVIII. *Hybrid Eggplants.* A fine specimen of the combination of "Ivory" upon the "Fordhook-Scarlet Chinese." The numerous lilac-colored fruits are nearly spherical with white interior.

Size.	Color.	Leaves.	Spines.	Flowers.	Number of Fruits.
No. 1. . Dwarf	Green	Medium smooth	No	Light purple	4
No. 2. . Dwarf	Purple	Medium rough	No	Purple	20
No. 3. . Dwarf	Purple	Medium rough	No	Purple	40
No. 4. . Tall	Green	Medium rough	No	Purple	250
No. 5. . Dwarf	Purple	Medium rough	No	Purple	0
No. 6. . Dwarf	Green	Medium smooth	No	Purple	18
No. 7. . Dwarf	Green	Medium smooth	No	Purple	23
No. 8. . Dwarf	Purple	Medium smooth	No	Purple	9
No. 9. . Dwarf	Purple	Medium smooth	No	Purple	30
No. 10. . Tall	Green	Medium rough	No	Purple	19
No. 11. . Medium tall	Green	Medium rough	No	Purple	7
No. 12. . Tall	Purple	Medium smooth	No	Light purple	90
No. 13. . Medium tall	Purple	Medium smooth	No	Light purple	85

In connection with the above records, the following tabular statement is made of two factors, namely, (1) plant habit and (2) spinoseness.

(1) Plant habit.	Tall.	Medium.	Dwarf.
Four tall parents gave offspring	3	7	5
Four medium parents gave offspring	5	8	4
Two dwarf parents gave offspring	8	1	12
(2) Spinoseness	Spiny	Spineless	
Four spiny parents gave offspring	15	5	
Five spineless parents gave offspring	3	23	

When unrestricted pollination prevails, it is seen that, in a general way, the character of the mother plant controls that of the offspring; this is particularly noticeable in the cases of dwarf plants and those that are without spines. When the smooth plants and the dwarfs are bred within themselves, it is hoped that one may predict the results with a large degree of accuracy.

WHITE EGGPLANTS WITH THE "CHINESE."

The hybridizing of two white varieties of the "American" eggplants with the "Chinese" is interesting from several standpoints but particularly that of color. Thus, the blend of the "Ivory" upon the hybrid "Fordhook-Chinese" (26//14/25) is quite strongly marked with the white of the pollen parent. A plant is shown in Plate XVIII, where it is noted first of all that the fruits are nearly spherical and smooth and the whiteness is somewhat in evidence where a fruit chances to have a dark background of foliage. As a matter of fact, the fruits are lilac and white, mixed more or less so that they might be called lilac blush because the color varies greatly and is often more developed upon one portion of the fruit than another, this seeming to be due to the amount of exposure to the light.

The interior of the fruits is even whiter than the outside because of the absence of the lilac and are very handsome as sliced. Here there is a case, shown in all the plants, of the white character of the parent dominating that of the orange of the "Chinese"and the purple of the "Fordhook."

A similar case to the above is that of the "Round White" when bred upon the same hybrid ("Fordhook-Chinese") as described for the"Ivory"and has the fractional record of 29//14/25. A single plant of this is shown to the left in Plate XIX. The shape of the fruits is different from the last in being more oval than spherical but the lilac blush is strongly developed and the interior is decidedly white.

THE KEEPING QUALITY OF EGGPLANT FRUITS.

One of the most serious defects of the ordinary eggplant fruits is their lack of keeping quality and, unless the grower looks after his crop almost daily, the fruits will decay upon the plants. The "Leaf-Spot" disease *(Phyllosticta hortorum Speg)* is one that makes large brown blotches upon the leaves and, when it once makes a start upon the fruit, the destruction of the specimen is very rapid. For this reason, the marketmen are shy of holding any surplus of eggplants and, in spite of this, the loss by the dealers is far too great.

As a matter of fact, there are some American sorts of eggplants that are much less subject to decay than others, as for example, the "Round White" and the "Dwarf Purple" and, to a less extent, the "Black Snake." Of late, the "Round White," has become one of the leading breeders among these plants and certain crosses have been produced that show much merit and particularly as to the keeping quality of the fruits. For example, in a double cross, namely, the "Round White" (29) upon a union of the "Dwarf Purple" (6) upon the "New York Improved" (19), all of which is expressed by the figures 29//6/19, the most impressive quality that at once appeals to the crop-grower is the number of the fruits, which is many times that of ordinary eggplants and the practically entire absence of decay, even when the fruits are left on to full maturity.

The "Round White" is a small-fruited sort that seems to be nearer to the wild form of the species than the common garden varieties, as, for example, the seed-cavities are few, often four, and well defined, a condition quite different from that found in

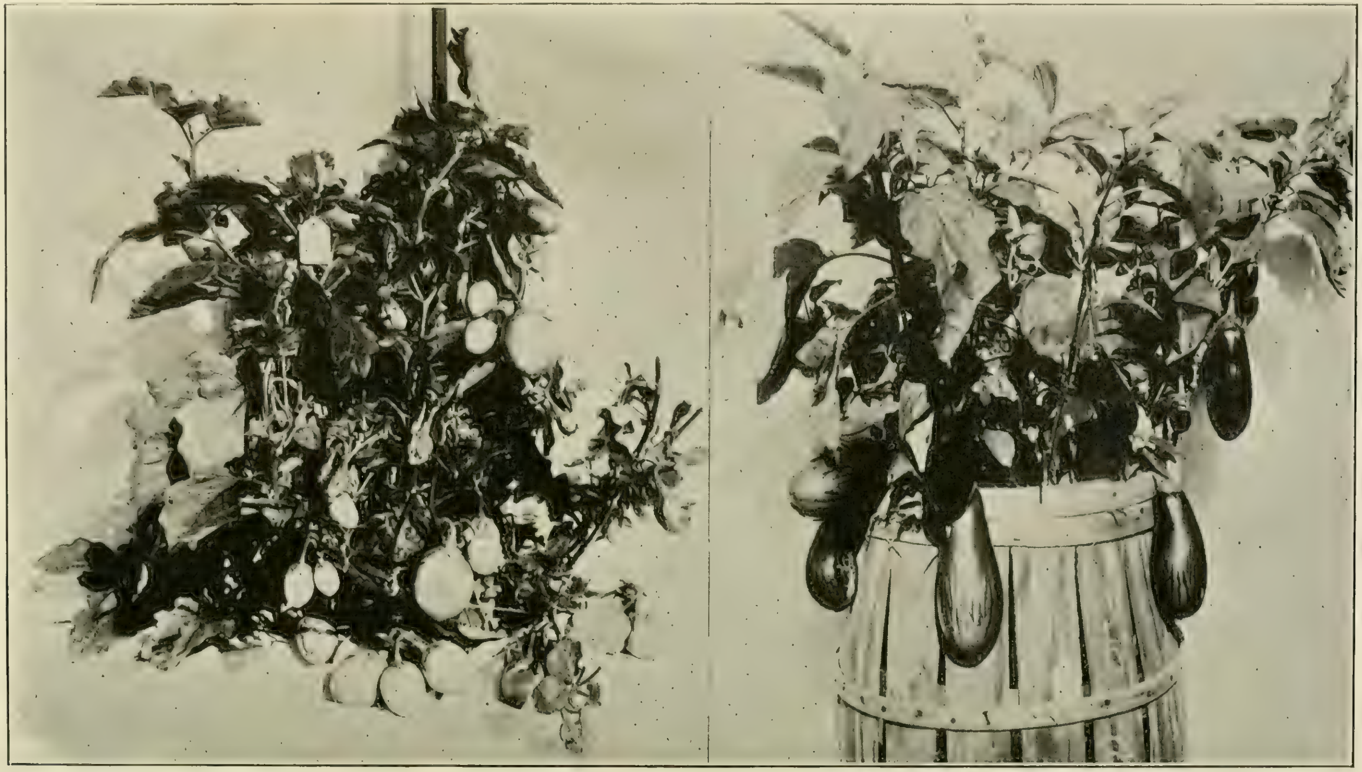

Plate XIX. *Eggplants.* Upon the left is a plant of the "Round White" bred upon "Fordhook-Scarlet Chinese," showing nearly white fruits. Upon the right is a sample eggplant fruit grown in a barrel.

the "New York Improved" or other of the large-fruited sorts. The extra keeping quality is chiefly due, in all probability, to the tough skin through which the germs of disease find it difficult to grow and induce decay within. As the tough skin is a portion that is removed in preparing the flesh for the table, it is evident that in itself it cannot be of any disadvantage to the cross that may retain this characteristic, while the interior of the "Round White" is being enlarged and improved by the union.

EXPERIMENTS WITH LIMA BEANS.

"JACKSON WONDER" CROSSES.

This group includes the six crosses of "Jackson Wonder" upon each of the following varieties, namely, "Burpee," "Dreer," "Henderson," "Willow-Leaf," "Woods" and "Station Bush," all white-seeded bush Limas, and five (not including "Jackson Wonder-Dreer") were secured in 1904, being now in the fourth generation.

Notes as to plant habit have been previously given (1906), to which the following statements are added:

The "Burpee" set gives plants whose leaves average larger than those of the "Jackson Wonder" while the pods, although larger than the dark-seeded parent, have in no case this year equalled the "Burpee" in size.

Since the "Henderson" resembles the "Jackson Wonder" very closely in habit, the plants are a uniform lot.

The "Willow-Leaf" set, through selection, is giving plants with the narrow type of foliage combined with the mottled seed, a novelty of, perhaps, no commercial value but of interest to the breeder.

The "Woods' Runner" set, because of its undesirable tendency was discarded and selection of bush plants only was made, with the result that this cross is giving a uniform lot of very prolific plants with the medium large pod of the "Woods."

The "Station Bush" set continues to produce an occasional running plant but is quite uniform, giving plants similar to the "Jackson Wonder" and "Woods."

It will be seen that pole sorts, through selection, might easily be obtained from the "Woods" and "Station Bush" sets as well as from the "Dreer;" in fact, true pole beans of the "Jackson Wonder-Station Bush" cross (lighter red and white) have been grown this season, giving early, prolific plants which breed true to seed-color.

In 1906, a seed classification of this set was made upon the basis of color and included five groups, namely, (1) like the male parent and called "Jackson Wonder," (2) "dark red," (3) "lighter red," (4) "mottled red" and (5) "white" like the female parent. The "dark red" (2) is the color most nearly like that present in the seeds of the blend plant, that is, the direct result of the cross.

The "Jackson Wonder," "dark red" and "lighter red" strains have occurred in all the crosses but the "mottled red" (brick red) has thus far appeared only in the "Henderson," "Willow-Leaf" and "Station Bush" combinations, while the "Burpee" alone has failed to give white-seeded plants.

For this year's crop, shown in the table below, seed was selected from plants which, in turn, were produced by seed of the same color, thus insuring in all cases where this season's harvest gave true seed, the same color type for three successive generations.

This indicates in the white-seeded sorts, for example, that no blood of a dark-seeded plant had been introduced through the parent or grandparent.

TABLE OF "JACKSON WONDER" CROSSES.

Color of Seed planted.	Cross Used.	Number of Plants. Grown.	Per cent. Breeding True.	Number of Pods per Ten average Plants.
"Jackson Wonder" type.	"Jackson Wonder-Burpee"	84	98.8	44
" "	" " " - Dreer"	37	67.5	45
" "	" " " -Henderson"	123	99.1	48
	"Jackson Wonder-Willow-Leaf"	99	70.7	30
" "	" " " -Woods"	41	65.8	28
" "	" " " -Station Bush"	94	74.4	30
Dark red	" " " - Burpee"	30	50.	26
" "	" " " -Dreer"	193	59.8	43
" "	" " " -Henderson"	99	61.6	34
" "	" " " -Willow Leaf"	167	77.8	23
" "	" " " -Woods"	101	90.0	39
" "	" " " -Station Bush"	240	66.5	35
White	" " " -Dreer"	41	97.5	31
"	" " " -Henderson"	290	98.6	37
"	" " " -Willow Leaf"	164	97.8	43
"	" " " -Woods".	481	96.2	48
"	" " " -Station Bush"	92	85.5	38

The average per cent. for all the "Jackson Wonder," "dark red" and "white" types, respectively, is 79.3, 67.6 and 95.1. As indicated by the last column, the largest yield is among the

"Jackson Wonder" and "dark red" groups, the total averages in their tabular order being 37.5, 33.3 and 39.4, respectively. Two thousand and three hundred and seventy-six plants of this set were grown the past season and a reference to the table will show the degree of conformity to type in respect to color inheritance.

The evidence given above is not sufficient to warrant the statement that the two seed colors, "Jackson Wonder" and "dark red," are always associated with the most prolific plants but it does seem safe to conclude that both the "Jackson Wonder" and "white" strains are being established through selection and isolation.

"JACKSON WONDER-DREER" CROSS.

The "Dreer" is a variety of the "Potato Lima" type, possessing a distinct foliage in its long, slender, light green leaves together with the characteristic short thick pods, containing round, meaty, greenish white seeds. These several distinguishing traits, taken from the standpoint of breeding, make this cross the most interesting, if not the most important, of the "Jackson Wonder" set.

Since the "Jackson Wonder" has a dark green foliage with shorter and broader leaves than the "Dreer," the progeny, as might be expected, gave plants which, in their leaf character, may be classed in three groups, one for each parent type and a third termed "intermediate" for the reason that the plants of this class, in respect to foliage, are a medium between the other two.

Such a classification was made in the case of one hundred and seventy-two plants of this cross and sixty-four were included in the "Jackson Wonder" group, seventy-four in the "intermediate" and thirty-four were classed as having "Dreer" foliage.

Plants grown this season were from seeds of a "Jackson Wonder," "dark red" and "white" types, representing two hundred and ninety-one plants. The choicest of these, those from white seed, were grown on the "Strip Land" and gave but one plant with colored seeds (dark red).

About half of the white-seeded plants bore a close resemblance to "Dreer" in general habit of growth and type of pod, while less than half gave the plump, round seed possessed by that parent. The strong running tendency, noted last year, which was also a trait of the "blend" plant, dominated this season's growth as well, there being two hundred and fifty plants with this character, or 85 per cent. of the entire number. These, with proper training, would no doubt develop into pole beans.

The harvest revealed much variation in respect to season from the earliness of the "Jackson Wonder" to the late "Dreer," while the pods represented various sizes and shapes from the large flat, approaching the "Burpee," to the short plump form of the mother but none were found identical with the "Dreer" as the round, plump, white seeds were smaller than those of the parent.

	Average length of pod	Average width of pod	Average number of seeds.
"Jackson Wonder" (91)	7—3-4 m.m.	2 m.m.	3.25
"Jackson Wonder-Dreer" (91-80)	8—3-4 m.m.	2—1-4 m.m.	3.18
"Dreer" (80)	7—1-4 m.m.	3—1-4 m.m.	2.7

The above statement is the result of an actual measurement of fifty pods in each of the three cases, the pods of the cross having been gathered from as many different plants.

As indicated, both the average length and width of pod in the offspring exceed corresponding dimensions of the "Jackson Wonder" but the "Dreer" is surpassed in average length only. The average number of seeds per pod is greater than that of either parent.

Plate XX represents the seed types which have appeared in the above cross, together with the parents at 1 and 8.

The seeds at 2, while appearing to be of the "Jackson Wonder" type, are really a "mottled pink" suggesting the mottled red but the peculiar red color is lacking. The plant represented was prolific, bearing ninety-one pods with the seeds flat like the mottled-seeded parent. Number 3 was selected from a running plant which bore eighty-three pods with seeds of the "Jackson Wonder" markings but with the "plumpness" of the "Dreer." Its parentage was of similar type. This plump or flat shape of the seed is a subject of further study.

The flat, dark red seeds shown at 4 are larger than either parent, resembling in outline and size the "Burpee" but are a reproduction of the blend type in color, that is, the first plants from the cross in question yielded seeds like these. Number 5 shows seeds of a light red color but smaller and plumper than those at 4. This represents another very prolific running plant bearing sixty-five pods. The flat, white seeds at 6 are not like either parent in size or form and also were produced by a running plant.

The white seeds at 7 show plainly the thick, meaty character of the "Dreer" but are smaller than either parent. This type promises to be a valuable addition to the list of novelties.

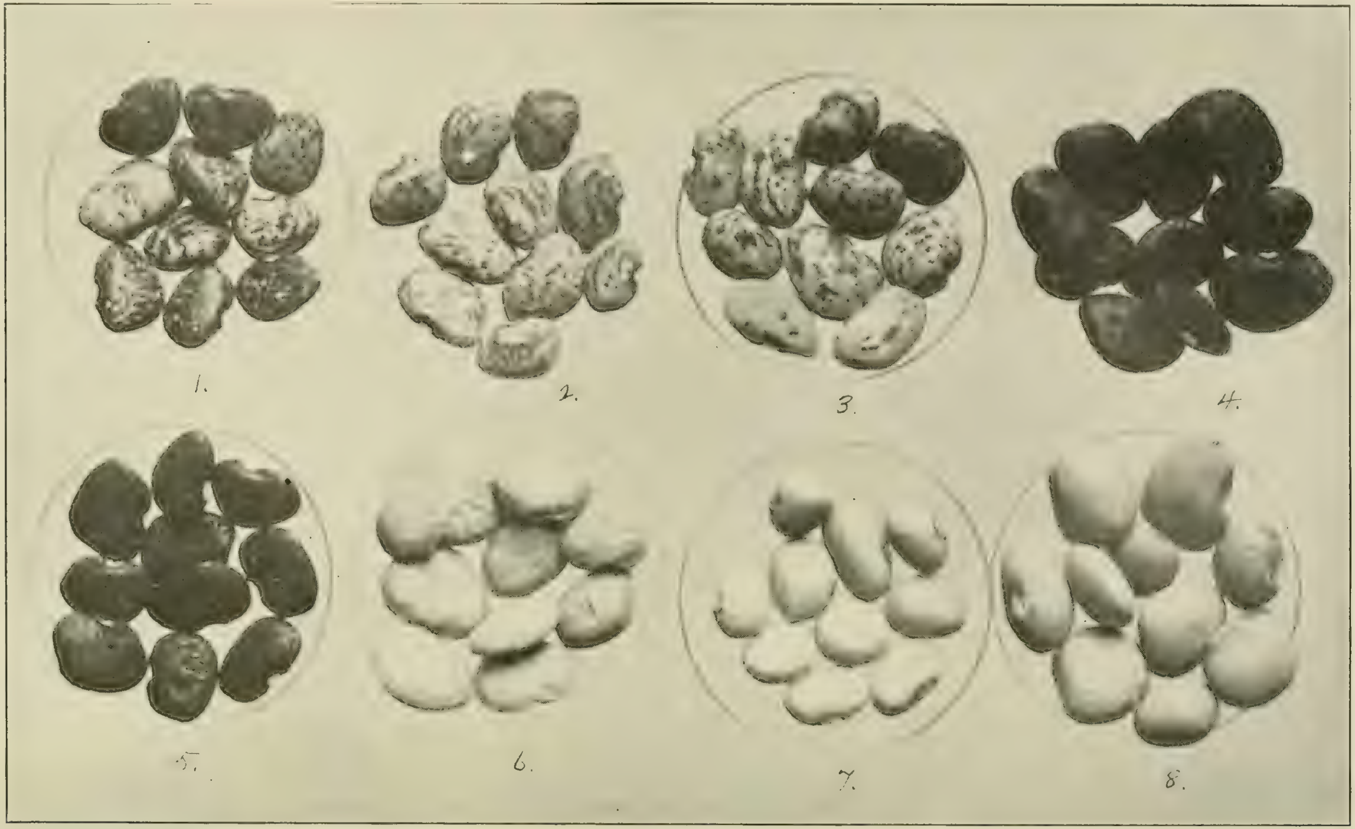

Plate XX. *"Jackson Wonder-Dreer" Cross Beans.* Six stains of seeds as to color and shape are shown.

SELECTION EXPERIMENTS WITH LIMA BEANS.

As stated last year, plants from the selected "plump" seed of the "Station Lima" showed a strong running tendency and gave little hope of an improved bush type.

Considering the seed alone, the "plump" when compared with the "flat" shows a decided contrast as pictured two years ago (Plate XII, 1906 report), indicating that a rigid selection through successive generations will establish both types. One secret of success in this line of experiments is to save seed of each plant separately, selecting in this case with the one thought of the form of seed.

The selection of "dark" and "light" types from the "Jackson Wonder," pictured in the same plate (1906), has been continued, giving seeds this season which, with few exceptions, are of a solid dark red scarcely to be distinguished from the type which, as noted elsewhere, is characteristic of the blend form when the "Jackson Wonder" is bred with white varieties.

EXPERIMENTS WITH BUSH BEANS.

Thirty-five crosses of bush beans were grown during the past season, twenty-five of which were white-seeded and represented in most cases established types.

Aside from "Longfellow-White Marrowfat" (26/29) and "Jones' Stringless-Golden Eye" (131/130), seed of which has already been distributed, the following are considered most promising:

"Longfellow-Brittle Wax" (26-101). The plants of this cross were a medium-early, prolific bush, many bearing long, round, curved, stringless wax pods.

"Crystal Wax-Market Wax" (145/135). This combination represented by the second generation from the blend, has produced a variety of types. Plants of the blend were spreading with pink flowers and numerous, medium-sized, flat, green pods containing dark mottled seeds. As stated last year, the plants of the first generation were variable, producing either green, wax or crystal wax pods with seeds black, mottled, dark brown, light brown or white. The one hundred and twenty-five plants grown this season from seed of these five types have shown more or less variation. The per cent. breeding true are as follows: Dark brown, 16 per cent.; mottled, 40 per cent.; black, 51 per cent.; light brown, 78 per cent, and white, 100 per cent. The last two colors represent the two parents. A new white-seeded wax pod

is one end in view through selection, also a "crytal wax" pod combined with the light brown seed of the "Market Wax."

"*French Stringless-Triumph of the Frames*" (179/180). This cross between two green-podded bush varieties, the former with round pods and mottled seeds and the latter with flat pods and white seeds, has given a desirable type in a compact bush plant, medium-early in season, bearing round, stringless, white-seeded green pods. As it is prolific and shows no running tendency, it promises to be a good sort for forcing as well as an excellent field variety.

"*Golden Scimitar-Davis*" (129/111). From selected white seed of plants bearing the long, round, curved, stringless wax pods, a uniform lot of plants has resulted the past season, strictly bush in habit with white flowers and early in season, together with the desirable type of pod stated above. This promises something good for the trucker.

"*Crystal Wax-Davis*" (145/112). Continued selection in this case has resulted in a small spreading type of plant resembling more the "Crystal Wax" than the "Davis" in this respect as well as in the medium late season. The small, round, curved, white wax pods are very brittle and of superior quality. This cross is being bred with other sorts with the aim of improving the plant habit and increasing the size of pod, while retaining the desired white wax character.

"*Livingston's Pencil Pod-Davis*" (148/112). Selection has been made of white-seeded plants with the "narrow-leaved" foliage of the male parent, bearing medium long, flat to rounding, curved, stringless wax pods. It is a prolific strain and is superior to "Davis" in the possession of a stringless pod.

These are but a few of the numerous bean crosses, which have been obtained during the past three or four years representing those most desirable from the standpoint of the trucker or the farmer. But when considered by the breeder as material from which principles may be obtained for guidance in future work, all are of value, the majority being kept in the background until they throw light upon the problems whose solution is to be attempted by a new line of experimentation now under way.

In order to test the prolificness of our two snap bean novelties (Station No. 1 and Station No. 2), selected seed from each, together with the parents, was planted in Series VII, Plot II, in the order of the table below. Each parent and cross was represented by one hundred plants, or three rows, making eighteen rows for the entire lot.

Station Snap Bean No. 1 ("Jones' Stringless-Golden Eye") gave thrifty, low, bushy plants coming into bearing with "Golden Eye" but with a plumper, more slender pod and little or no stringiness.

The plants of Station Snap Bean No. 2 ("Longfellow-White Marrowfat") early showed a resemblance to the male parent in their upright bush habit and produced flower stems borne above the foliage, characters quite distinct from the "Marrowfat" with its spreading growth and hidden blooms. The pods were ready for market as soon as the "Longfellow" and fully a week ahead of "Marrowfat" and the pods remained green longer than those of the "Longfellow."

	Number of Pods	Number of Seeds	Average Number of Pods per Plant	Average Number of Seeds per Pod
"Longfellow" (26) 10 plants	201	727	20.1	3.6
"Longfellow-White Marrowfat" (26-29) 10 plants.	232	750	23.2	3.2
"White Marrow-fat" (29) 10 plants.	210	604	21	2.9
"Jones' String-less" (131) 10 plants.	209	532	20.9	2.5
"Jones' Stringless-Golden Eye" (131-130) 10 plants.	289	645	28.9	2.2
"Golden Eye" (130) 10 plants.	166	341	16.6	2.5

It is seen from the table that the average number of pods with the four parents is 196.5, while that for their two crosses is 260.5. In like manner, the average number of seeds for the parensts is 551 and for their crosses, 697.5. In other words, so far as this experiment goes, the cross far outdoes the parents in the number of pods and seeds per plant.

REPORTS FROM TESTERS OF STATION SNAP BEAN NO. 1.

(1) "This variety had white pods about three inches long. They were free from strings and very tender. A very good bean for family use. Bushes grew about twelve inches tall." (2) "The snap beans did well considering the weather." (3) "This is a strong-growing plant with large pods and is very full of beans." (4) "This is a good grower with tender pods and the best I ever raised." (5) "The pods were of a nice size and were yellow in color." (6) "There was strong growth and free fruiting with the Station Snap Bean No. 1." (7) "This was injured by drought but the beans were of excellent quality." (8) "This has a low, sturdy bush which is very productive of light yellow, large pods of fine flavor." (9) "The plants were vigorous and productive of yellow, tender and nice pods; they grew one and a half feet high." (10) "This bean turned out finely and I am much pleased and

will plant same next year from seed raised by me this year. The beans are of good flavor and healthy growth." (11) "The bean was a success, ripening with a yellow pod which was very tender." (12) "These beans are a good yielder." (13) "This did very well considering the exceedingly dry weather at the time. The plants were of good size and yielded very well indeed. On the whole, I considered this variety a success." (14) "The plants were about fourteen inches high, branched nicely and were full of yellow, almost transparent pods." (15) "The snap bean was fine; I did not plant it until late and the beans were large enough to eat by the first of September." (16) "This was early, vigorous and productive." (17) "Large, healthy, vigorous bush with a splendidly formed bean in a good plump pod." (18) "The size of the pod was medium and the quality was good." (19) "This had a long, white, round pod with white beans. It was very good and I have saved some of the seed." (20) "The beans are stringless and very tender, of good quality. Each pod had four to seven beans." (21) "I found these beans to be the best of the yellow varieties I have ever grown. The pods were from four to five inches in length, very tender and of fine flavor. The plants were heavy yielders and I had beans from them from June 1st and am still picking some, September 16th." (22) "These plants produced a large crop of medium-sized pods, the growth was quick and they were ready several days ahead of other varieties." (23) "Was a good bearer and pods were of decidedly good flavor." (24) "An excellent snap bean. Planted May 16th, picked June 25th. It is a vigorous grower and a prolific yielder of cream-colored pods." (25) "The plants were small but very productive and pods were of good flavor." (26) "This has been very good. The plants were healthy, free from disease, prolific bearers of good-sized pods of good quality." (27) "This bean was very good." (28) "The plants were medium-sized, vigorous and very productive. Produced waxy white pods, uniform in size and shape. Altogether extremely satisfactory bean." (29) "Sowed seed May 13th, the pods were ripe July 6th. The plants were productive, bearing pods four to five inches long." (30) "The beans did very well." (31) "A good yielder with a few green pods among the yellow; pods somewhat flat in shape, and very tender and sweet." (32) "There was a good growth of vine. The plants were prolific and had a very long season. We had edible pods for two months from one planting. The yellow, medium-sized pods were of superior quality. They were good raw as a salad with salt and pepper. They are unlike any others I have tested." (33) "The beans were entirely satisfactory, being vigorous and productive." (34) "There was a good yield of yellow, uniform pods of good quality." (35) "I found it to be a good bean in quality." (36) "This bean was very productive, without any rust." (37) "The bean proved to be remarkably good and the growth was fine." (38) "I planted the seed May 18th and the pods were large enough to eat June 30th. The plants are good yielders of good quality pods. It is a fine variety to look at in the lot." (30) "This variety is a good yielder and the beans are fine when cooked. They are as good as I have ever raised and I do not expect to grow any other kind for some time to come." (40) "The bushes were loaded from the time they started to bear until about September 13th. The bean is white with yellow pods and makes a good string bean for cooking." (41) "The beans were first-class in every respect. The vines were vigorous and the pods long and full." (42) "This variety was quite productive; the pods were very crisp and fine for eating." (43) "This plant had a dwarf, bushy habit of growth. The pods were yellow, stringless, and with white seeds." (44) "The beans were fine and when cooked were nice and tender." (45) "I cannot praise this bean too highly. It is tender, absolutely stringless and delicate in flavor. The pods were wax-like and free from blemishes." (46) "The bushes were of good size and filled with pods; the quality of the fruit was very good." (47) "This sort of bean is very suitable for light soil. The pods are about five inches long and were borne abundantly. This variety does not rust as others of this kind have done." (48) "The beans are all right, entirely stringless and very tender and juicy with a good flavor. The plants are strong and hardy and yield well." (49) "This bean turned out very well, the pod is six inches long and there are five beans in a pod. The plant is prolific and hardy and the bean is of good flavor." (50) "The bean was successful. The plant was very vigorous and very prolific." (51) "This was a good grower and an abundant yielder. It is a fine table bean." (52) "The plants are of vigorous growth with plenty of foliage. The pods are of good size, yellow in color and of good quality." (53) "A fine bean for use as a green bean; it is very productive." (54) "This bean is prolific and of good quality." (55) "This kind of bean is very productive of medium-sized pods. It stood the drought well, and when cooked, nothing could be better." (56) "The beans were very nice, the pods were four or five inches long and very tender." (57) "Had good success with this bean. The plant was very vigorous and very prolific." (58) "We liked the beans very much." (59) "The beans grew well and yielded a large crop, the plants averaging ten inches high. They had vigor and productiveness and the pods color and uniformity. They lack nothing." (60) "This is a vigorous, productive and good eating bean." (61) "This did very well, could not have been any better." (62) "The beans came up well and were very fine." (63) "These plants grew about one foot high, with yellow pods, which were about four inches long and well-filled." (64) "An excellent bearer and very prolific of sweet, tender pods. It is one of which you may be proud." (65) "They were very fine and did well. The color of the pods is pure white and the taste is fine. In fact, this variety was all right in every respect." (66) "The plants were very productive. The long pods were excellent for table use." (67) "The pods were borne abundantly, were of good flavor and fine when cooked." (68) "The pods were flat, wax, and of good flavor." (69) "Very prolific plants with medium-sized, stringless pods. I am well pleased with this variety." (70) "I had best success with these stringless beans, could not have had better." (71) "The plants bore productively." (72) "The plants were very productive. The pods were yellow and very tender." (73) "This was a small plant but the best bearer I ever saw and the pods were the best tasting after cooking." (74) "The plant is vigorous and productive and the pods are uniform and pale yellow in color." (75) "The bush is small, compact and well filled with beans, which last a long time. They are not in the least affected by blight. Very good quality." (76) "They were very good." (77) "I had a good crop of fine tasting beans." (78) "The plants grew well and were very full of pods which were filled out nicely with beans. This is a very good tasting bean." (79) "I had fine success with the beans, which bore medium-sized pods of fine flavor." (80) "The plants were good bearers and the beans were of good flavor. I consider this variety a success." (81) "This was very good, bearing plenty of pods which contained beans of good quality." (82) "The plant is of good size and a vigorous grower. The pods are yellow with white beans of medium size."

REPORTS FROM TESTERS OF STATION SNAP BEAN NO .2.

(1) "The beans were vigorous and productive." (2) "The strong plants gave a good yield of medium-sized pods." (3) "Good quality, early and desirable." (4) "Pods very tender and of a uniform type." (5) "The green pod is long and fleshy; the plants were very productive." (6) "The beans were very tender and productive; they were excellent in every way." (7) "I planted the seed and the plants grew in about six weeks and yielded well. The green pods were very tender. A fine bean." (8) "The vines were of rather vigorous growth and set full of beans of good quality." (9) "The snap bean was of good quality and the plants were productive." (10) "The plants were fairly productive and the pods of good quality." (11) "The beans were very nice and tender and ripened early; the plants were very prolific." (12) "The plant was vigorous and productive." (13) "The plants were vigorous and very productive, the pods were green, and uniform in size and color." (14) "These were very vigorous plants, which averaged

twenty pods per plant. These pods were five to six inches long and nearly round."

"SCARLET RUNNER" HYBRIDS.

Considerable space was given to the hybrid between the "Scarlet Runner" and "Tennessee Bush," nine hundred and fifty plants being grown upon Strip II.

Great variation in plant habit (small compact bush, medium and running), in season of blooming and in color of seed has continued together with the wide range of flower color from white through pink, salmon and crimson shades to purple.

The various types of seed colors which have appeared are grouped as follows: Dark purple or black, dark mottled (including mottled purple), solid brown, mottled brown, gray, mottled gray and white, with many variations under each group.

Forty-two of the plants were selected because of bearing salmon flowers and thirteen of these with mottled gray seeds were associated with salmon-colored flowers; all of these plants were descended from a common grandparent with the same characteristics, seed of which is shown at 5 in Plate XVII of the report for 1906.

Several plants from dark red seed, recorded last year as B-17, have conformed very closely to the parent. The bright crimson flowers, borne on long flower stalks, extend beyond the foliage, while the bushy plants produced pods which resembled those of the "Scarlet Runner." The bloom has all the attractiveness of its scarlet parent, while the bush habit of plant has its advantages.

Another plant, B-9-5-1, was remarkable for its prolificness; it was of spreading habit with an inclination to run and late in bearing, its pods being round, green marked with purple and of medium length. One hundred and sixty pods and five hundred and forty-three seeds were counted at harvest time, giving an average of over three seeds per pod. These seeds are dark red, in some cases purple and of medium size, many having flattened ends due probably to crowding in the pod. Its grandparent was a heavy bearer, followed by a set of offspring that yielded well.

Five plantings of selected white seeds from as many plants have given 78, 94, 96 and 100 per cent. (two cases), respectively, of plants breeding true to the one factor of the parent, namely, white seeds.

The "Scarlet Runner-China Red Eye" (63/9) hybrid, which is a generation behind the above, (63/43), is similar to it in variations in flower, plant and pod. Seed from sixteen of last year's plants (B-1, B-2, etc.) were planted, producing one hundred and thirty-six offspring. Most of these were bush plants and early to medium-early in season, bearing flowers with numerous shades of color from purple through crimson and pink to pure white. The pods were green and varied from short flat to long curved, some resembling "Scarlet Runner" very closely. In harvesting this set, the selection of salmon and crimson plants was the plan adopted as outlined above. Several plants appeared with a white flower larger than the normal snap bean and closely resembling the "Dutch Runner"—a white form of the "Scarlet Runner" and differing from it in color of flower and seed.

NOVELTIES AMONG BEANS.

These novelties were grown chiefly to make a test of their value commercially and for breeding. It is evident that many differ only slightly from other named varieties. Crosses have been secured with several of the list, either among themselves or with kinds that have been upon the experiment grounds for some years.

No. 217. *"Black German Wax."* A late black wax with a strong inclination to run. It comes into bearing late and produces flat pods.

No. 218. *"Buckbee's New Golden Lima."* Failed.

No. 219. *"Burger's Green-Pod Stringless."* A pole bean with good-sized, plump, medium early pods, flowers and seeds white. It is a desirable breeder and is being crossed with the bush form.

No. 220. *"Burpee's New Kidney Wax."* This is a medium early bush variety bearing medium long, flat, stringless, wax pods. Seed white.

No. 221. *"Bush-Butter Lima."* This variety resembles "Henderson's Bush" in plant and pod.

No. 222. *"Bush Wax."* A strong growing bush plant, medium late with broad, flat, straight, medium long, wax pods, which are slightly stringy. Sent out as a selection from "Powell's Yellow Giant" pole bean.

No. 223. *"China Pink Eye."* This sort is an early green-podded bush with pink flowers and medium long, flat, straight, stringy green pods.

No. 224. *"Dwarf French."* This variety gave a poor stand of dwarf bush plants bearing short, flat, curved, stringy wax pods.

No. 225. *"Dwarf Green-Seeded Matchless."* An early bush with white flowers and long, curved, flat, stringy wax pods.

No. 226. *"Early Soja."* (*Glycine hispida*). The plants of this sort are tall, thrifty and late, possessing all the characters of the "Soy" bean. Grown for purposes of breeding but no crosses were obtained.

No. 227. *"Fulmer's Forcing."* The plants are early and thrifty, resembling "Canadian Wonder" (8) in habit. The flowers are pink and the pods long, flat, straight, stringy and green.

No. 228. *"German Stringless."* This is an early, green-podded bush with medium long, flat, curved, stringy pods.

No. 229. *"Early Giant Bush."* A medium early bush Lima with pods nearly as large as "Burpee" but with smaller seeds.

No. 230. *"Hinrich's Giant White."* a medium-sized, early, green-podded bush with white flowers, bearing long, flat, straight, stringy pods.

No. 231. *"Lazy Wife."* A good pole variety with white flowers, long, brittle pods and white seeds. Not new to the public but grown for breeding purposes.

No. 232. *"Hardy Wax."* This sort gave a poor stand of medium early bush plants, with medium long, flat, curved, stringless wax pods.

No. 233. *"New Crystal White Wax."* The first planting failed, so that corresponding notes were not obtained. The second planting gave spreading plants full of white blooms late in the season.

No. 234. *"Newington Wonder."* This sort also gave a poor stand and was replanted. Plants of medium height with pink flowers.

No. 235. *"New Marvel."* A Lima bean, inclined to run and medium late in season with large pods and greenish white seeds.

No. 236. *"New Speckled Wax."* A medium early bush with long, round, curved, stringless wax pods.

No. 237. *"New Monster Stringless."* This is a bush wax, medium early in season, bearing medium long, flat, curved pods.

No. 238. *"New Stringless White Wax."* An early bush variety with short, flat, straight, stringless wax pods.

No. 239. *"New White Valentine."* This is a medium early bush, bearing long, flat, curved, wax pods with slight stringiness.

No. 240. *"Osborn's Forcing."* An early green-podded bush variety with pods of medium length, flat, straight and stringy.

No. 241. *"Phenomenon."* Failed.

No. 242. *"Pink Eye Wax."* Failed.

No. 243. *"President Roosevelt."* This is a green-podded pole bean, medium early in season with long, stringless pods and white seeds. (It is a promising sort for breeding with bush varieties and crosses have been secured with it).

No. 244. *"XXX Bush Butter."* A promising sort, medium early bearing, long, slightly curved, round, stringless wax pods.

No. 245. *"XXX Bush."* A medium early green-podded variety with short, round, curved, stringless pods.

No. 246. *"Painted Lady."* In plant habit, this pole bean resembles the "Scarlet Runner." The bloom differs from that sort in being marked with white.

No. 247. *"Roger's Lima Wax."* This is apparently the same as the "Lima Wax" previously grown under the number 175.

No. 248. *"Trucker's Delight."* This is a large-podded pole Lima bean with good-sized pods and large, plump seeds.

No. 249. *"Two-Colored Fire."* An ornamental pole bean which resembles "Painted Lady" (246).

No. 250. *"Walter's Prolific Thick Green."* This is a pole Lima and a good strong climber with pods not so long as the "New Ideal" (216) but thicker with plump, greenish white seeds of the "Potato Lima" type.

No. 251. *"Warwick."* An early, green-podded bush variety with short, flat, straight, stringy pods.

No. 252. *"Wilkie's Perfection Prize."* This pole Lima is not a strong climber, bearing pods similar to those of the "New Ideal" but is not so prolific. Seeds large and greenish white.

No. 253. *"Yard Long"* (*Dolichos sesquipedalis*). A species with very long pods and identical with the "asparagus bean" heretofore grown. It is of interest from the breeding standpoint.

No. 254. *"Watchung Lima."* A pole Lima which resembles the "Speckled Lima," having a smaller, smoother pod but the same seed markings.

No. 255. *"Butterfly Runner."* Another type of "Scarlet Runner" with red and white blooms but has proved to be a weak grower and is less hardy than number 63.

No. 256. *"Station Snap Bean No. 1."* Seed of this novelty, distributed last spring, represents a cross between "Jones' Stringless" and "Golden Eye" both parents being strictly bush varieties and early in season. The selected type is a medium-sized, prolific bush plant, early in season, with white flowers and medium-sized, curved, plump, nearly stringless pods.

No. 257. *"Station Snap Bean No. 2."* This novelty, seed of which was also distributed last spring, is a cross between "Longfellow" and "White Marrowfat" combining the plant and pod characters of the "Longfellow" with the white flower and seed of the "Marrowfat." Earliness and form of seed are also inherited from the male parent.

EXPERIMENTS WITH SQUASHES.

The work of breeding squashes began in 1903 and results from the crosses were first obtained the following year. Since then a large area has been allotted each season for experimentation with both summer and winter squashes.

SUMMER SQUASHES.

Until the present season, the chief line of study among summer squashes was an endeavor to establish new and attractive types, particularly those answering to the ideal commercial squash. Along this line of work a detailed study was given to the existing conmmercial varieties. Considerable effort has been made to investigate the underlying principles governing the crosses. While most of these investigations are still under study, they were briefly as follows: Relation of direct offspring (blend) to parents in points of shape of fruit, color of fruit and shape of seed; relation of first generation to the parents; the effect of crossing within the variety (commercial or distinct cross), or within the plant upon type and prolificness; correlation between size of seed and size of fruit; correlation between the amount of "flesh" and size of fruit; and correlation between color of vine and color of fruit.

The work of the past season consisted chiefly in further study of the influence of crossing and continual selection upon shape, color and surface characteristics. A study was also made of blends as related to their parents with the aim of finding out the characteristics existing among squashes and their relation to each other.

CROSSING AND CONTINUED SELECTION TO ESTABLISH CROSS.

Squashes, from the ease with which they wide-fertilize, due to unisexual flowers and great attractiveness for insects, are ordinarily not uniform in their characteristics. Even old commercial varieties of squashes often produce many types of fruits. Crosses between distinct varieties are established with much difficulty. For example, some of the crosses made in 1903 were subjected to continual selection at once; others were crossed again the following year and then subjected to continual selection. The selection consisted in growing seeds from desirable fruits formed by pollinating within the plant, for which the initials W. P. are used, or between plants of the same cross (W. C.).

Below is given a list of crosses showing the stages of variability through four years of selection. The "selection" of one year becomes the "progeny" of the next.

	1905.	
Cross.	Progeny.	Selection.
"Yellow Crookneck// Cream Scallop/ Yellow Crookneck" (5//6/5)	"Jugs" more numerous than flat, chiefly cream, some yellow and striped, slightly warty.	(1) Warty "jug," fluted, W. P. (2) Warty "jug," fluted, W. C.
	1906.	
	Generally smooth "jugs" not fluted, variable color.	(1) Orange green, smooth jug, not fluted, W. P. (2) Smooth green "jug," not fluted, W. C. (3) Smooth cream "jug," fluted, W. P.

1906—Continued.

Cross.	Progeny.	Selection.
	More generally smooth "jugs" not fluted, variable color	(1) Smooth cream "jug," not fluted, W. P. (2) Warty cream "jug," fluted, W. C. (3) Smooth cream "jug," fluted W. C. (4) Smooth cream "jug," fluted, W. C.
	1907.	
	Uniform lot of green, slightly warted "jugs."	Slightly warted green crookneck, W. P.
	Uniform lot of green, slightly warted shortneck "jugs."	Slightly warted green shortneck "jug," W. P.
	"Jug" type prevails, green to cream, somewhat warty.	(1) Warty cream "jug," W. P. (2) Warty cream "jug," W. C.
	"Jug" type prevails, cream to yellow, warty.	(1) Smooth cream, deep scallop, W. P.
	"Jug" type and longneck, warty, cream to yellow.	(2) Warty fluted "jug," W. P.
	"Jug" type prevails, few warts, cream to yellow.	Smooth white "jug," W. C.
	"Jug" and deep scallop, white to yellow, warty.	Warty cream "jug," W. C.
		Warty, cream short, scallop, W. P.
	1908.	
	All similar to parent. Origin of the "Jersey Green."	
	All similar to parent. Origin of the "Jersey Green."	
	Still variable in shape, color and wartiness.	
	Still variable in all characteristics.	
	All similar to parent in color and smoothness; new uniform shape, short neck "jug."	
	All similar to parent in color and wartiness; new uniform shape, shortneck "jug."	
	Still variable in all characteristics.	
	Still variable in all characteristics.	
	Still variable in all characteristics.	

1905

Cross.	Progeny.	Selection.
"Yellow Crookneck//Cream Scallop/Strickler's Summer" (5//6/11).	"Jugs" more numerous than flat and longneck, chiefly yellow, some cream and striped, very warty.	Warty, oval, not fluted, W. P.
	1906.	
	Oval and "jug," warty, not fluted, chiefly yellow.	Warty cream "jug," not fluted, W. P.
	1907.	
	Warted "jug" prevails, white to yellow.	Warty "jug," W. P.
	1908.	
	All similar to parent in type but still variable in color.	
	1905.	
"Cream Scallop/Yellow Crookneck" (6/5).	Slightly more "jugs" than flat, cream, slightly warty.	Warty "jug," fluted, W. C.
	1906.	
	"Jug" and longneck, warty, cream yellow, striped, fluted, and not fluted.	(1) Smooth, yellow, striped, longneck, not fluted, W. C. (2) Warty, yellow striped, "jug," fluted, W. C.
	1907.	
	"Jug" type prevails, warty, striped yellow.	(1) Slightly warty, scallop, W. P. (2) Striped, warty, crookneck, W. P. (3) Striped, warty, oval, W. C.
	Deep scallop prevails, warty, cream to orange.	(1) Striped, warty, scallop, W. P. (2) Striped, warty, scallop, W. C.
	1908.	
	All similar to parent in color, but still variable in shape.	
	All similar to parent in shape color and wartiness.	
	Still variable in all characteristics.	
	All similar to parents in color but still variable in shape.	
	Still variable in all characteristics.	

Cross.	Progeny.	Selection.
	1905.	
"Cream Scallop/Yellow Crookneck" (6/5) W. C.	Flat and "jugs," chiefly cream and striped, slightly warty.	Warty, fluted, longneck, W. C.
	1906.	
	Variable, mostly "jugs" and longnecks.	Smooth cream, long-neck, not fluted, W. C.
	1907.	
	Longneck prevails, warty, cream to yellow.	Smooth white "jug," W. P.
	1908.	
	A new uniform color and wartiness, slightly warted yellow "jug."	
	1905.	
"Cream Scallop//Yellow Crookneck/Cream Scallop" (6//5/6).	Chiefly flat and "jugs," few longneck, cream, yellow, striped, slightly warty.	Smooth, flat, scallop, W. P
	1906.	
	Uniform lot of white flat, smooth, scalloped.	Smooth white "cheese" not fluted, W. P.
	1907.	
	Uniform lot of "cheese" type, smooth, white.	(1) Smooth white "cheese," W. P. (2) Medium white "cheese," W. P.
	1908.	
	A new uniform shape, small white "acorn." A new uniform shape, medium white "acorn."	
	1905.	
‘Cream Scallop/Yellow Crookneck//Yellow Crookneck/Cream Scallop" (6/5//5/6).	Chiefly flat, some "jugs," cream, slightly warty.	Smooth, fluted "jug," W. P.

1906

Cross.	Progeny.	Selection.
	Generally smooth, fluted "jug," striped with yellow.	Smooth yellow "jug," fluted, W. C.
	1907.	
	"Jug" type prevails, many fluted, smooth, cream to yellow.	Fluted cream "jug," W. C.
	1908.	
	A new uniform color, fluted, striped "jug."	
	1905.	
"Early Bush//Yellow Crookneck/Cream Scallop" (8//5/6).	Chiefly flat, some "jugs," cream, slightly warty.	Warty, oval, not fluted, W. P.
	1906.	
	Generally smooth, fluted "jugs," yellow.	Smooth orange, long neck, not fluted, W. P.
	1907.	
	Warted crookneck prevails, greenish orange.	Warted green crook neck, W. C.
	1908.	
	Still variable in all characteristics.	
	1905.	
"Strickler's Summer/Golden Bush" (11/9).	All yellow "jugs," slightly warty.	Warty, rectangular, scalloped, W. P.
	1906.	
	Chiefly rectangular, warty, scalloped, orange.	Smooth, orange, oval, fluted, W. P.
	1907.	
	Uniform lot of long orange, fluted.	Long orange, fluted, W. P.
	1908.	
	All similar to parent in shape, color and smoothness. Origin of "Fluted Orange."	

BLENDS OF SUMMER SQUASHES.

The blends grown this year are of three classes: (1) Those between distinct summer varieties, (2) those between summer squashes and a winter squash belonging to the same species (*Cucurbita Pepo*), (3) those between summer squashes and pumpkins. While none of these blends are expected to breed true, they afford abundance of material for new promising squashes. Only class 1 falls properly among summer squashes; and while classes 2 and 3 set fruit almost at the same time as the summer squashes, their season of growth is so long that they are treated among the winter varieties.

Only a general description of the blends of class 1 is given below. A study of these in relation to their parents is combined with all the other blends of summer and winter squashes and treated together. (See Biometric List of Blends, page 261).

"Golden Bush-Bush Fordhook" (9/51). This cross between an orange scallop and a cream, oval-shaped fruit gave a progeny of several different types, showing the blending of parental forms in different degrees approaching one or the other parent; among these we find attractive, smooth, bell-shaped fruits fluted at the base (Plate XXI). All the fruits are smooth and the color is generally cream though a few are slightly yellow. The female parent, "Bush Fordhook," is ranked for its quality and thickness of flesh among the best summer squashes but it appears much later than the early sorts. This strain crossed with an early variety produced fruits that are thick in flesh, good quality and earlier than "Bush Fordhook."

"Bush Fordhook-Strickler's Summer" (51/11). This cross between a cream, oval-shaped, smooth fruit and an orange, warty crookneck gave several different types showing one or the other parent in different degrees (Plate XXI). Among these we find fruits of "Fordhook" type which are much larger than the parent and just as smooth. The flesh is thick like the "Fordhook" and the fruits develop much earlier than that parent. While the colors range from cream to orange, many are striped.

"Mammoth White Scallop-Bush Fordhook" (10/51). It is interesting to notice that, while both parents are smooth, many in the progeny are warted. The range of new type, showing the blending of both parents, extends to either parent (Plate XXI). The flesh is not as thick as the "Fordhook" but fruits are set much earlier. The colors range from cream to yellow.

"Michigan-Mammoth White Scallop" (53/10). Here we have a combination between a superior quality squash and the ordi-

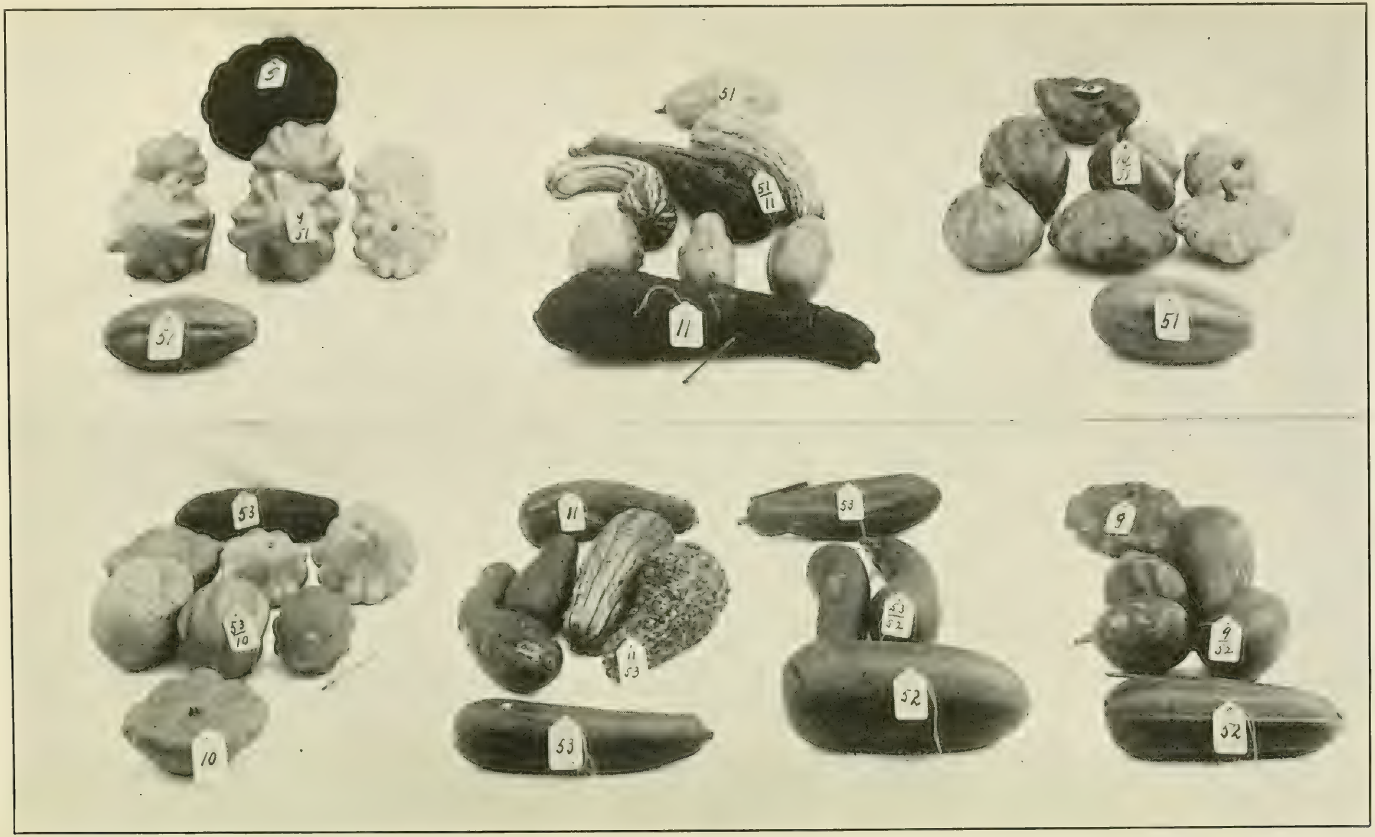
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PLATE XXI. *Crosses of Summer Squashes.* Seven groups of crosses with their parents are shown.

nary scallop, between a vine plant and a bush, and finally between a dark green and a cream-colored squash. The shapes of the parents are also distinct, one is long and slender, the other short and scalloped. Here again, the progeny shows different types. While the forms grade, none approach the male parent as much as the female parent (Plate XXI). In color, they are all like the female parent. Among the types we find some resembling the "Fordhook." One improvement over the fine male parent is the thickness of flesh. This is another instance where two smooth parents produce some slightly warted fruits. The blends were a week earlier than the late parent. The plants were running but not to the same extent as the "Michigan."

"Strickler's Summer-Michigan" (11/53). Nearly alike in shape, the fruits of the two parents differ in their surface characteristics, quality and earliness. The fruits vary from smooth to very warty; none have the dark green color of the "Michigan," but are either orange like "Strickler's Summer" or striped. Here again, the flesh is thicker than that of the fine "Michigan" variety. The blends gained in earliness but the plants remain bushy and do not run like the "Michigan." (Plate XXI).

"Michigan-Cocozelle" (53/52). Here is a combination between a small and a very large fruit, the former of much superior quality. The progeny, however, gave fruits resembling the smaller parent in size. Except having the "Michigan" smooth like the "Cocozelle," which we find among the blend offspring, no particular value is gained in this cross. It is observed, however, that the running habit of the male parent dominates in the blend. (Plate XXI).

"Golden Bush-Cocozelle" (9/52). This cross between a small scallop and large elongated fruit gives perfectly oval to slightly elongated fruits which are green or striped like the female parent with the body orange like the "Golden Bush." The flesh is thicker than that of "Cocozelle," and the plants are much earlier than that parent. (Plate XXI).

REPORTS FROM TESTERS OF "JERSEY GREEN" SQUASH.

(1) "The plants were quite vigorous and productive. The fruit was quite uniform in shape and the quality was good." (2) "This squash is excellent, about twelve to fifteen inches in length." (3) "The vines are very thrifty and prolific, the fruit ranging from ten to twenty-four inches long." (4) "This squash is very fine and prolific. It has a delicious flavor especially when fried. Have never raised anything before so satisfactory as this variety. The fruit was heavy and club-shaped and there were a few twins." (5) "This is a strong growing vine bearing a large fruit, which is very good when fried." (6) "The fruit was of fine size, long in shape and yellow in color." (7) "This squash was of medium size, tender and of fine flavor." (8) "This was very good. One fruit grew ten inches long and eighteen inches around

the largest part. The leaf measured eighteen inches in length by eight in width. The squashes were very nice. In fact they were all vigorous, productive and nearly uniform in size." (9) "We found the squash to be of very good quality." (10) "These plants grew well and were very productive." (11) "A very good bearer and early." (12) "These squashes did well, yielded well and were of good quality." (13) "The squash was fine; the plants commenced to bear early." (14) "The squash grew very well for the dry weather." (15) "The plant started well and bore two squashes, which were very good sliced and fried. The fruits were about five inches in diameter and very tender." (16) "This was a vigorous grower; the fruits were variable in color, and of very good flavor." (17) "Quality and yield good." (18) "The vines were very productive and the squashes were of good quality." (19) "Had a very luxuriant vine, growing tall and strong. The flavor of the squash, when properly prepared and cooked was very superior to the ordinary summer crooknecks." (20) "The plants were large, vigorous and productive. In flavor the fruit was equal to and superior to the yellow crookneck." (21) "This squash is fine and long, sweet and tender, fine for baking." (22) "This was a squash of very good quality with a strong and stocky plant." (23) "The summer squash I planted May 18th and had squashes large enough to eat June 30th. The plants are good yielders and the fruit is of good quality." (24) "This squash is all right." (25) "The vines are strong and healthy and yield well." (26) "These summer squashes are of different shape and color and I like them very much." (27) "This variety is prolific and the fruit is wonderfully uniform in shape." (28) "The vine makes a rank growth. The fruit is of fair size and good flavor and ripened up quickly." (29) "They are very nice." (30) "A good tasting sort." (31) "These grew finely; they were good yielders and the squashes were of fine flavor."(32) "I found this squash very nicely flavored, dark green in color and fine when used the same as eggplant; the plants were prolific." (33) "Very productive." (34) "The vines are vigorous." (35) "The plants were not very large but quite productive. The shape of squash is nearly straight with a rather short neck. The color is a rich dark green. The fruit is quite uniform and entirely wartless." (36) "This variety of squash was fine and yielded a fair crop. The table quality of the fruit is fine." (37) "They did very well and all the squashes were of good flavor." (38) "The squash was very nice, bore early a great many fruits." (39) "They were fine." (40) "This squash had a small vine with small fruits." (41) "The squash came up well and grew well. I was very much pleased with the fruits." (42) "The squashes were very good." (43) "The squash is of excellent quality and fine flavor."

REPORTS FROM TESTERS OF "FLUTED ORANGE" SQUASH.

(1) "The squash grew well." (2) "The size of plant was medium large, the growth was vigorous and there has been absolutely no sign of blight to date." (3) "The squashes were of excellent quality." (4) "The squash was six or eight inches long, fine for eating." (5) "I had these squashes abundantly; I had enough for my neighbors as well as for my family." (6) "The summer squash yielded well." (7) "These squashes were fine, very nice fried or boiled. There were a great many on the vines."

NEW ESTABLISHED CROSSES.

In addition to the two crosses which bred true last year, represented in the upper half of Plate XXII, six others of uniform color and surface character appeared this season.

1. A composite cross of "Scallop" and "Crookneck" (5//6/5), after five years of selection, gives a handsome short neck "jug"

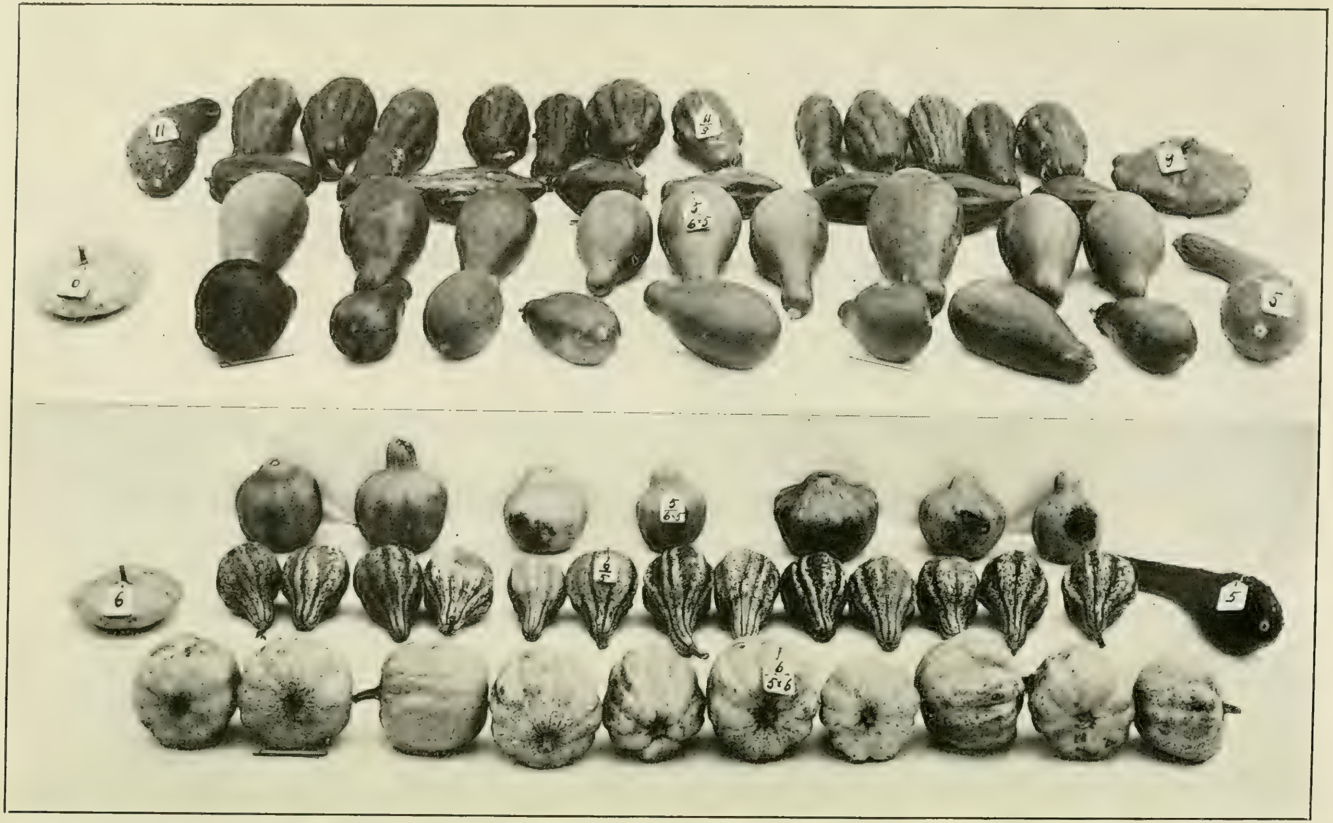


PLATE XXII. *Established Crosses among Summer Squashes.* The upper half shows "Fluted Orange" above and "Jersey Green" below; lower half shows three promising crosses in the three rows, respectively.

of medium to large size with the cream-colored surface not warty and the flesh about an inch thick. This is shown in the upper row of the lower half of Plate XXII.

2. This is the same cross as No. 1 and the fruit is in all respects similar to it except that it is warty.

3. A straight cross of "Scallop" upon "Crookneck" (6/5), after five years of selection produces a small to medium, warted "jug" fruit; the surface is cream-colored with green stripes.

4. A straight cross of "Scallop" upon "Crookneck" (6/5), after five years of selection, yields a large, warted "jug," cream-colored fruit with medium thick flesh.

5. A composite cross of "Scallop" and "Crookneck" (6/5//-5/6), after five years of selection, gives a short neck, medium-sized "jug" fruit, slightly fluted; the green-striped surface is not warty. This is shown in the middle row of the lower half of Plate XXII.

6. A composite cross of "Scallop" and "Crookneck" (6//5/6), after five years of selection, gives a nearly spherical fruit about five inches in diameter, the cream-colored surface is not warty and the flesh is very thick. This is shown in the bottom row of the lower half of Plate XXII.

EXPERIMENTS WITH WINTER SQUASHES.

Until the present season the work with winter squashes was practically along the same lines as with the summer squashes, except that special emphasis was given to the thickness of flesh and the keeping quality of the fruit.

The work this season consisted chiefly in the study of selection and of blends in relation to their parents from both the scientific and commercial points of view. As the aim was to acquire a knowledge of distinct unit characters and of their relation to each other, biometric records had been kept for each blend and for each of its parents through the entire life cycle. Following is a biometric list and summary of the blends which for convenience, includes also the blends of summer squashes.

Record number of plant.	Type of plant.	Time of first appearance of male flower in days.	Time of first appearance of female flower in days.	Form of fruit.	Surface of fruit.	Color of fruit.	Size of fruit.	Thickness of flesh in centimeters.
11	Bush.	41	46	Straightneck, long.	Warted.	Yellow	Medium large. .	2.0
Blend	Bush	39	49	More like male.	Smooth to few warts.	Light yellow, striped.	Larger than either.	3.0
19	Running.	53	56	Nearly round.	Smooth.	Cream and striped.	Very small.	2.0
6/5	Bush.	39	44	"Jug" form	Warty.	Cream.	Very small.	1.5
Blend.	Running.	39	44	Variable.	More or less warty.	Cream and striped.	Medium to large.	2.5
19	Running.	53	56	Nearly round.	Smooth.	Cream and striped.	Very small.	2.0
10/11	Bush.	39	44	Scallop.	Few warts.	Cream.	Very small.	2.0
Blend.	Running.	39	49	More like male.	Smooth.	Cream or striped.	Larger than either.	2.0
19	Running.	53	56	Nearly round.	Smooth.	Cream and striped.	Very small.	2.0
46	Running.	39	62	Oval.	Smooth.	Orange.	Large.	3.0
Blend.	Bush.	39	49	Intermediate.	Few to many warts.	Orange.	Larger than either.	3.5
5/6//11	Bush. .	39	49	"Jug" form.	Warty.	Yellow.	Very small.	1.5
10	Bush.	43	48	Scallop.	Smooth.	Cream.	Small.	3.0
Blend.	Bush.	38	49	Strongly like males.	Smooth.	Cream to yellow.	Intermediate.	3.0
46	Running.	39	62	Oval.	Smooth.	Orange.	Large.	3.0
8	Bush.	41	46	Scallop.	Smooth.	Cream.	Very small.	2.0
Blend.	Bush.	36	49	Intermediate.	Smooth to few small warts.	Cream to light pink.	Nearly like female.	3.0
46	Running.	39	62	Oval.	Smooth.	Orange.	Large.	3.0
38	Running.	48	64	Oval, grooved.	Smooth.	Cream.	Very small.	2.0
Blend.	Running.	50	54	Like the male.	Smooth.	Light yellow.	Small.	2.5
32	Running.	47	51	Oval, pointed.	Smooth.	Striped, green and yellow.	Very small.	2.0
38	Running.	48	64	Oval, grooved.	Smooth.	Cream.	Very small.	2.0
Blend.	Running.	53	67	More like female.	Smooth to few small warts.	Light yellow.	Large.	3.5
36	Bush.	47	52	Cylindrical.	Smooth.	Dark green.	Medium large.	2.0
32	Running.	47	51	Oval, pointed.	Smooth.	Striped.	Very small.	2.0
Blend.	Running.	54	59	More like female.	Smooth.	Striped.	Very small.	2.0
19	Running.	53	56	Nearly round.	Smooth.	Cream and striped.	Very small.	2.0
19	Running.	53	56	Nearly round.	Smooth.	Cream and striped.	Very small.	2.0
Blend.	Running.	50	55	More like female.	Smooth.	Striped.	Very small.	2.0
32	Running.	47	51	Oval, pointed.	Smooth.	Striped.	Very small.	2.0

Record number of Plant.	Type of plant.	Time of first appearance of male flower in days.	Time of first appearance of female flower in days.	Form of fruit.	Surface of fruit.	Color of fruit.	Size of fruit.	Thickness of flesh in centimeters.
27	Running.	49	53	Bottle shape, curved neck.	Smooth.	Dull green.	Medium large.	2.5
Blend.	Running.	39	49	More like male.	Smooth.	Dull green.	Small.	3.0
1	Running.	45	63	Pear shape, curved point.	Smooth.	Dark green.	Medium large.	4.0
16	Running.	42	57	Oval.	Smooth.	Dark green.	Very large.	4.0
Blend.	Running.	41	52	Majority intermediate.	Smooth.	Light green.	Intermediate.	3.5
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
18	Running.	49	63	Bottle shape, curved neck.	Smooth.	Green and striped.	Medium large.	2.5
Blend.	Running.	39	54	More like female.	Smooth.	Yellow and striped.	Small to medium large.	3.5
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
15	Running.	56	68	Flat, corrugated.	Warty.	Dark green.	Small.	3.5
Blend.	Running.	..	55	Intermediate.	Smooth.	Dark green.	Medium large.	4.0
16	Running.	42	57	Oval.	Smooth.	Dark green.	Very large.	4.0
25	Running.	41	47	Oval.	Smooth.	Orange.	Small.	3.0
Blend.	Running.	42	65	More like male.	Smooth.	Orange.	Large.	3.5
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
15	Running.	56	68	Flat, corrugated.	Warty.	Dark green.	Small.	3.5
Blend.	Running.	..	41	More like female.	Smooth.	Dark green.	Small.	4.0
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
18	Running.	49	53	Bottle shape, curved neck.	Smooth.	Green and striped.	Medium large.	2.5
Blend.	Running.	67	59	Intermediate.	Smooth.	Green and striped.	Medium large.	3.0
30	Running.	42	57	Flat.	Smooth.	Orange and striped.	Medium large.	3.0
1	Running.	45	63	Pear shape, curved point.	Smooth.	Dark.	Medium large.	4.0
Blend.	Running.	40	56	Long, round and oval.	Smooth.	Striped.	Small to medium large.	3.5
2	Running.	43	61	Pear shape, curved point.	Smooth.	Orange.	Medium large.	4.0
1/2	Running.	40	56	Round.	Smooth.	Salmon.	Small.	3.0
Blend.	Running.	43	59	Gradation to four parents.	Smooth.	Light to dark green.	Small to large.	4.0
3/4	Running.	43	62	Round.	Smooth.	Orange.	Medium large.	3.5
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
Blend.	Running.	43	65	More like male.	Smooth.	Gray to light green.	Medium large.	3.0
1	Running.	45	63	Pear shape, curved point.	Smooth.	Dark green.	Medium large.	4.0

Record number of plant.	Type of plant.	Time of first appearance of male flower in days.	Time of first appearance of female flower in days.	Form of fruit.	Surface of fruit.	Color of fruit.	Size of fruit.	Thickness of flesh in centimeters.
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
Blend.	Running.	43	62	Gradation to both parents.	Smooth.	Striped.	Small to medium large.	3.5
4	Running.	44	63	Pear shape, curved point.	Smooth.	Orange.	Small.	3.0
3	Running.	43	61	Oval or flat.	Smooth.	Dark green.	Small.	3.5
Blend.	Running.	43	57	Gradation to both parents.	Warty.	Dark green to lead.	Small.	3.0
21	Running.	45	60	Cheese form, navel.	Warty.	Lead.	Large.	4.5
7	Running.	51	68	Cheese form, navel.	Warty.	Orange.	Large.	4.0
Blend.	Running.	43	62	Majority intermediate.	Warty.	Orange.	Medium large.	3.5
2	Running.	43	61	Pear shape, curved point.	Smooth.	Orange.	Medium large.	4.0
4	Running.	44	63	Pear shape, curved point.	Smooth.	Orange.	Small.	3.0
Blend.	Running.	44	63	Like female.	Smooth.	Orange.	Medium large.	4.0
1	Running.	45	63	Pear shape, curved point.	Smooth.	Dark green.	Medium large.	4.0
26	Running.	43	49	Pear shape, curved point.	Warty.	Dark green.	Medium. large.	4.0
Blend.	Running.	40	49	Intermediate.	Warty.	Dark green.	Small.	3.5
25	Running.	41	47	Oval.	Smooth.	Orange.	Small.	3.0
9	Bush.	41	46	Scallop.	Smooth.	Yellow.	Medium large.	2.0
Blend.	Bush.	50	55	Gradation to both parents.	Smooth, some warty.	Cream.	Small to medium.	2.5
51	Bush.	50	62	Oval, grooved.	Smooth.	Cream.	Small.	2.0
9	Bush.	41	46	Scallop.	Smooth.	Yellow.	Medium large.	2.0
Blend.	Bush.	42	43	More like female.	Smooth.	Green and striped.	Medium large.	2.5
52	Bush.	53	57	Cylindrical.	Smooth.	Yellow and striped.	Large.	2.0
10	Bush.	43	48	Scallop.	Smooth.	Cream.	Small.	3.0
Blend.	Bush.	41	44	Gradation to both parents.	Smooth to warty.	Cream to yellow.	Small to medium.	2.0
51	Bush.	50	62	Oval, grooved.	Smooth.	Cream.	Small.	2.0
11	Bush.	41	46	Straightneck, long	Warted.	Yellow.	Medium large.	2.0
Blend.	Bush.	41	44	More like male.	Smooth to warty.	Yellow and striped.	Large.	2.5
53	Running.	51	59	Long, grooved.	Smooth.	Dark green.	Medium.	2.0
51	Bush.	50	62	Oval, grooved.	Smooth.	Cream.	Small.	2.0
Blend.	Bush.	40	44	More like female.	Smooth to warty.	Yellow and striped.	Large.	2.0
11	Bush.	41	46	Straightneck, long	Warty.	Yellow.	Medium large.	2.0

Record number of plant.	Type of plant.	Time of first appearance of male flower in days.	Time of first appearance of female flower in days.	Form of fruit.	Surface of fruit.	Color of fruit.	Size of fruit.	Thickness of flesh in centimeters.
53	Running.	51	59	Long, grooved.	Smooth.	Dark green.	Medium.	2.0
Blend.	Running.	42	49	More like female.	Smooth to few warts.	Cream.	Larger than female.	3.5+
10	Bush.	43	48	Scallop.	Smooth.	Cream.	Small.	3.0+
53	Running.	51	59	Long, grooved	Smooth.	Dark green.	Medium.	2.0
Blend.	Running.	41	46	Intermediate.	Smooth.	Light green.	Medium.	2.5
52	Bush.	53	57	Cylindrical.	Smooth.	Yellow and striped.	Large.	2.0

SUMMARY OF BIOMETRIC LIST OF SQUASHES.

		Number of blends.	Per cent.	Intermediates.	Per cent.	Remarks.
Plant:	Early and late.	18	76 early.	12	12 late.	
	Bush and running.	10	50 bush.	..	50 running.	
Leaf:	Large and small.	15	67 large.	20	13 small.	
	Slightly lobed and deeply lobed.	15	53 deeply lobed.	33	14 slightly lobed.	
Fruit:	Male parent and female parent.	32	25 like male.	28	28 like female.	19 per cent. intergrade.
	Large and small.	25	36 large.	40	12 small.	12 per cent. intergrade.
	Warty and smooth.	11	73 warty.	..	27 smooth.	Warts vary in number and size.
	Yellow and cream.	8	87 yellow.	13 Intergrade.	....	
	Striped and solid color.	9	33 striped.	..	67 solid.	Solid color in blend may be different from tnat of parent.
	Orange and green.	9	55 orange.	33 striped.	12 green.	
	Cream and green.	1	Cream.	..	......	
	Thick and Thinner flesh.	18	30 thickest.	40	22 thinnest.	

SOME GENERAL OBSERVATIONS DRAWN FROM THE STUDY OF BLENDS WITH THEIR PARENTS.

1. The vegetative function of the blend is usually greater than that of either parent.
2. The size of fruit of the blend is generally intermediate (sometimes larger than that of either parent).
3. The thickness of flesh of the blend fruit is quite generally the same as that of the thicker parent but sometimes exceeds it.
4. Earliness is generally dominant over lateness.
5. The deep-lobed leaf is usually more potent than the slightly lobed leaf.
6. The shape of fruit is equally influenced by both parents.
7. Wartiness is generally dominant over smoothness.
8. Yellow is most generally dominant over cream color.
9. Solid colors are quite generally stronger than the striped colors.
10. Cream color is dominant over green in the single blend obtained.
11. Orange color is quite generally dominant over green.
12. The male flowers, as a general rule, precede the female flowers; in the summer squashes the difference is from one to five days, and among winter varieties from two to four weeks.
13. In hybrids, the male flowers may not appear at all or later than the female flowers, in which case they lack pollen.

EXPERIMENTS IN SELECTION AMONG CROSSES.

In selecting crosses of winter squashes, the chief point in view was to learn whether shape, size, keeping quality and limited number of seeds are easy to establish. Below is given an account of the progeny of several selected fruits:

"Delicious-Hubbard" (3/1). ("Hubbard" type, few seeds). The progeny was variable in color and unlike either parent, the majority of the fruits being gray. The limited number of seeds of the selected mother fruit did not reappear.

"Delicious-Hubbard" (3/1). ("Hubbard" type, one and a half feet long). This cross gave a variable progeny and, out of fifteen fruits, only one showed length and that was less than one foot.

"Delicious-Bay State" (3/21). ("Bay State" type; long keeper). While the keeping quality of the progeny remains to be seen, the twenty-one fruits of this cross are interesting for the

almost perfect gradation of type and color to either parent. (Plate XXIII).

"Warren-Boston Marrow" (7/2 I). ("Warren" type, without a navel used). The fruits from this selected type are variable but the absence of navel of the "Warren" is constant.

"Warren-Boston Marrow" (7/2 I). ("Warren" type with the navel used). Some of the fruits in the progeny were with, and others without, the navel, but wherever the navel was present it was small (Plate XXIII).

"Delicious-Golden Hubbard" (3/4). ("Golden Hubbard" type, long, used). Not one of the fruits in the progeny was long. It is interesting to note that, while the mother fruit was orange, the entire lot of the progeny was like the male parent in color and shape.

"Golden Hubbard-Hubbard" (4/1). ("Hubbard" type, large, used). In this case, the size of fruit bred true but the dark green color of the mother parent did not appear; all were orange like the male parent.

These few instances of selection of winter squashes are sufficient to convince us that there is little hope for immediate results. We are now ready to see the behavior of a few crosses in the second generation or the third year after the cross.

"Hubbard-Boston Marrow" (1/2 II). The general shape of the fruits is nearly uniform. Of the fourteen fruits ten are striped, three solid green and one is orange, showing that the majority are beginning to acquire uniformity.

"Hubbard-Boston Marrow-Delicious-Golden Hubbard" (1/2//3/4 II). Most of the fruits are long. Of the seventeen fruits in the progeny ten are green, six green with orange spots and one solid orange. This cross also shows that type is tending to acquire uniformity.

"Delicious-Hubbard" (3/1 II). The crop is uniform in both shape and color.

"Delicious-Golden Hubbard" (3/4 II). All the fruits resemble the "Golden Hubbard" in shape, and nearly all in color.

The four cases quoted above indicate that, by continual selection, it will be possible to establish uniformity among crosses of winter squashes as well as among summer squashes, demonstrated the last two years.

It is here proper to speak of the variations that occur from time to time among commercial varieties. The "Cocoanut," which is a well-established, smooth-sized fruit, produced this season one plant, among forty or fifty, bearing fruits three to four times the ordinary size. In 1907, one fruit bred within the variety was slightly long. This selected fruit gave this season a uniform progeny of attractive cream-colored, slender fruits about seven inches long with a small seed cavity. They are valuable for their excellent quality as well as their appearance.

SOME STRIKING COMBINATIONS AMONG WINTER SQUASHES.

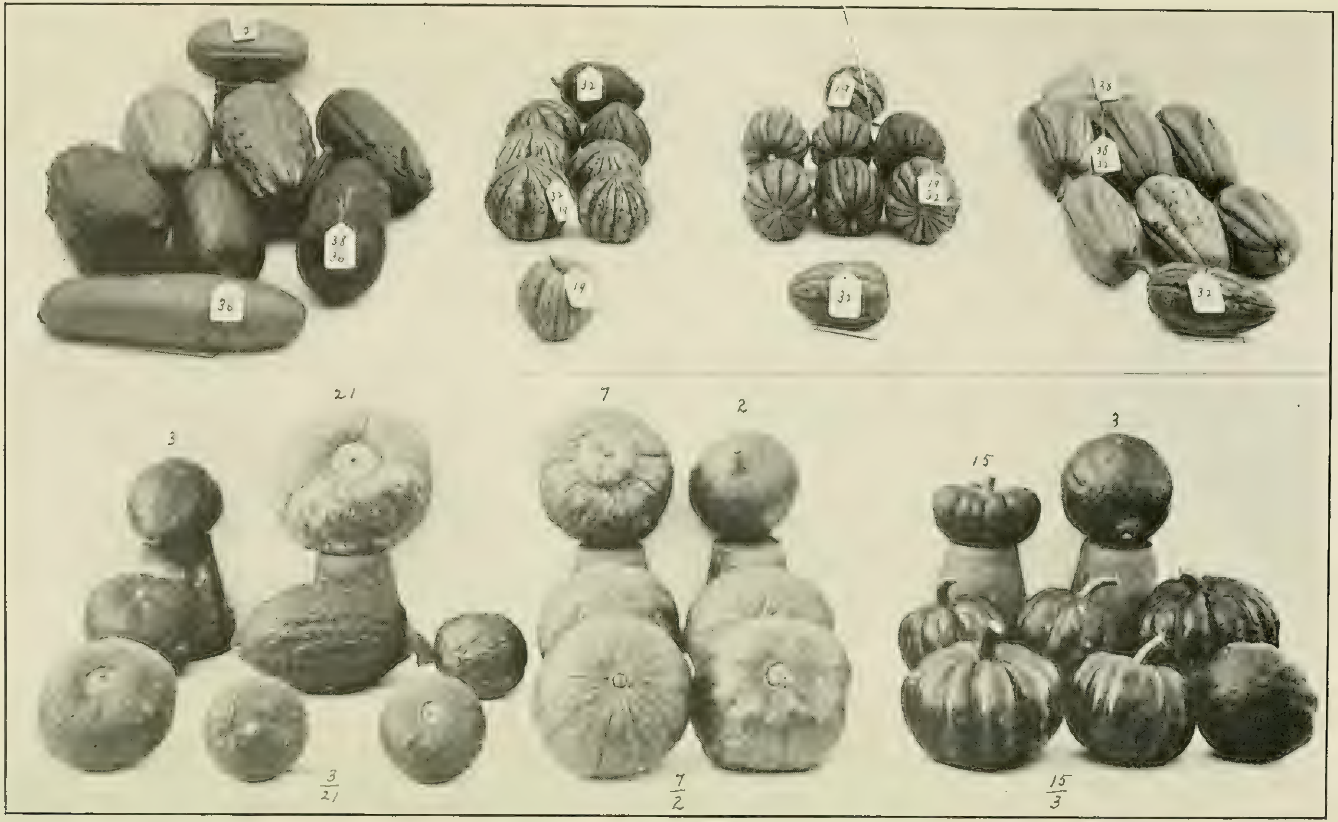
"Fordhook-English Vegetable Marrow" (38/36). When a small fruit is bred upon a large fruit, we frequently obtain larger fruits than those of either parent, particularly when the two parents are far apart. But, in such instances, it is always expected that the number of fruits would be less than in the small-fruited parent. In this combination, however, we have an instance where we not only get larger fruits but more in number, for the habit of this blend was to form a main thick stem about a foot long, with several branches in different directions and which gave about seven large fruits to the plant. The male parent is about two weeks later than the female parent and this tendency manifested itself in the progeny; though the plants produced female flowers at the time with the early parent, they failed to develop for nearly two weeks. The fruits resembled the female parent in shape. All uniform (Plate XXIII).

"Fordhook-Delicata" (38/32). This is a union between two distinct but equally fine varieties. The object of the cross was to obtain the "Fordhook" blood, which is very late, in a combination with a very early winter squash. This was accomplished, and more, it gave the attractive form of the male parent in a much larger size. The plants produced about five fruits each and of good quality. (Plate XXIII).

"Dunlap's Marrow-Delicious" (25/3). This cross represents a combination of a "Marrow" with a true winter squash, a fair with a very superior quality squash. The result of this union is an attractive, large, oval fruit of a solid orange color.

"Cocoanut-Delicata" (19/32). (Reciprocal crosses). The only practical difference between the parents is in their shape, one being oval and pointed and the other nearly round. While the forms slightly blended, it was apparent that in both instances the female dominated. The 32/19 has a more attractive fruit than its reciprocal. As tested, the quality of both crosses is superior. There were about six fruits per plant. (Plate XXIII).

"Canada Crookneck-Hubbard" (27/1). This is a hybrid between *C. Moschata* and *C. maxima*. The shape of the former is a curved neck "bottle," which crossed with the "Hubbard" type produced a new form of fruit that strongly suggests that



38
30
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3/21
7/2
15/3

PLATE XXIII. *Crosses of Winter Squashes.* Showing seven groups of crossed fruits with their respective parents.

of "Canada Crookneck;" with colors from gray to orange. The feature of this cross is the gain in earliness over the "Hubbard" by nearly two weeks; its flesh is intermediate to both parents. Unfortunately, all attempts to obtain a fruit within the cross have failed.

"Winter Crookneck-Delicious" (18/3). The two parents are similar to those in the preceding hybrid and the fruits were variable, the great majority of them resembling the "Delicious." Among all were four fruits which were entirely different from either parent, being large, cone-shaped and orange-colored. One fruit was secured by fertilizing within the cross.

"Winter Crookneck-Faxon" (18/30). This is a third hybrid with the two species represented by the parents blended in shape and color. The vigor of this hybrid was remarkable; while the vines were slender, its leaves were very large with the leaf stalks long as in summer squashes. The plants developed quite early for a winter squash and remained the latest in the field. But its extraordinary vegetative capacity had developed at the expense of its reproductive function for there were very few male flowers and these had no pollen whatever so that it was impossible to attempt fertilizing within the cross. It is to be understood that, while its function for perpetuating its kind had failed, fruits were formed quite readily with the pollen from other varieties giving about four fruits to the plant.

"Japanese-Mammoth Chili" (15/16). This is a union between two species. The "Japanese" fruit is flat and strongly ribbed, while that of the "Mammoth Chili" is large, oval and smooth. The combination of the two gave a medium, pear-shaped, slightly ribbed fruit. The two species, however, are so far apart that the blend failed entirely to produce male flowers, but the female flowers fertilized quite readily with some of the other varieties, giving about two fruits to the plant.

"Japanese-Delicious" (15/3). This is another hybrid between the Japanese species and *C. maxima*. It also failed to produce male flowers but the female flowers fertilized with other varieties, as is seen from the progeny which averaged four fruits to the plant. The fruit has the appearance of the "Japanese" but is much deeper. By reason of the "Delicious" blood contained in it, its table quality is reported to be superior. It is necessary to add that very few good seeds were formed with the fruit. (Plate XXIII). As elsewhere, the only striking difference in the behavior between crosses and hybrids is the weakening of the reproductive function particularly to the hindrance of its own perpetuation, but they combine readily with some other kinds.

SUMMER-WINTER CUCURBITS.

"Long Island Scallop-Yellow Crookneck-Cocoanut" (6/5//19), This combination consists of a summer cross and a winter variety used in the following cross. In this case both parents were small; one was a warty "jug," the other nearly round. The resulting fruits were about twice as large as either parent. There was a little variation in form, from oval to long. The color was cream with light yellow stripes; and the surface varied from smooth to warty. As shown below the fine quality of the "Cocoanut" impressed itself upon the cross, producing a summer squash with a superior quality, with the characteristic of not losing in "bulk" in cooking. The season began at the same time with that of the summer parent and lasted much longer. The plants were running, producing three to four fruits per plant. (Plate XXIV).

"Strickler's Summer-Cocoanut" (11/19). A long straightneck, warted summer squash with a round, small winter squash of two opposite qualities, gave an interesting combination, particularly from the standpoint of quality. The summer squash is watery and its bulk is reduced considerably after boiling. In the cross, which sets fruit almost at the same time as the summer parent, the quality of the fruit is far superior to that of the ordinary summer squash and it does not lose much bulk in cooking. Its texture is different from the summer squash and offers a valuable strain for selection. The bush character of the male parent was retained in the blend, which gave about two fruits, larger than either parent, to the plant and resembling the male in shape but with very few warts. The surface is cream-yellow with stripes. (Plate XXIV).

"Mammoth White Scallop-Strickler's Summer-Cocoanut" (10/11//19). This is a still different union of the summer and winter squash. The summer kind in this case was a scalloped fruit, itself a cross between a scallop and crookneck. When crossed upon the "Cocoanut," it gave fruits of the scalloped type but deeper than the parent "scallop;" they were also slightly larger than either parent. The color of the one or the other parent appeared distinctly in different fruits. The chief quality which this blend claims is its sweetness of flesh, which reminded those who tested it of the sweet potato. The proportion of the cream-colored to the striped was as three to one. The plants retained the running habit of the "Cocoanut" and produced about five fruits each which are excellent keepers. (Plate XXIV).

"Early Bush-Field Pumpkin" (8/46). This cross combines

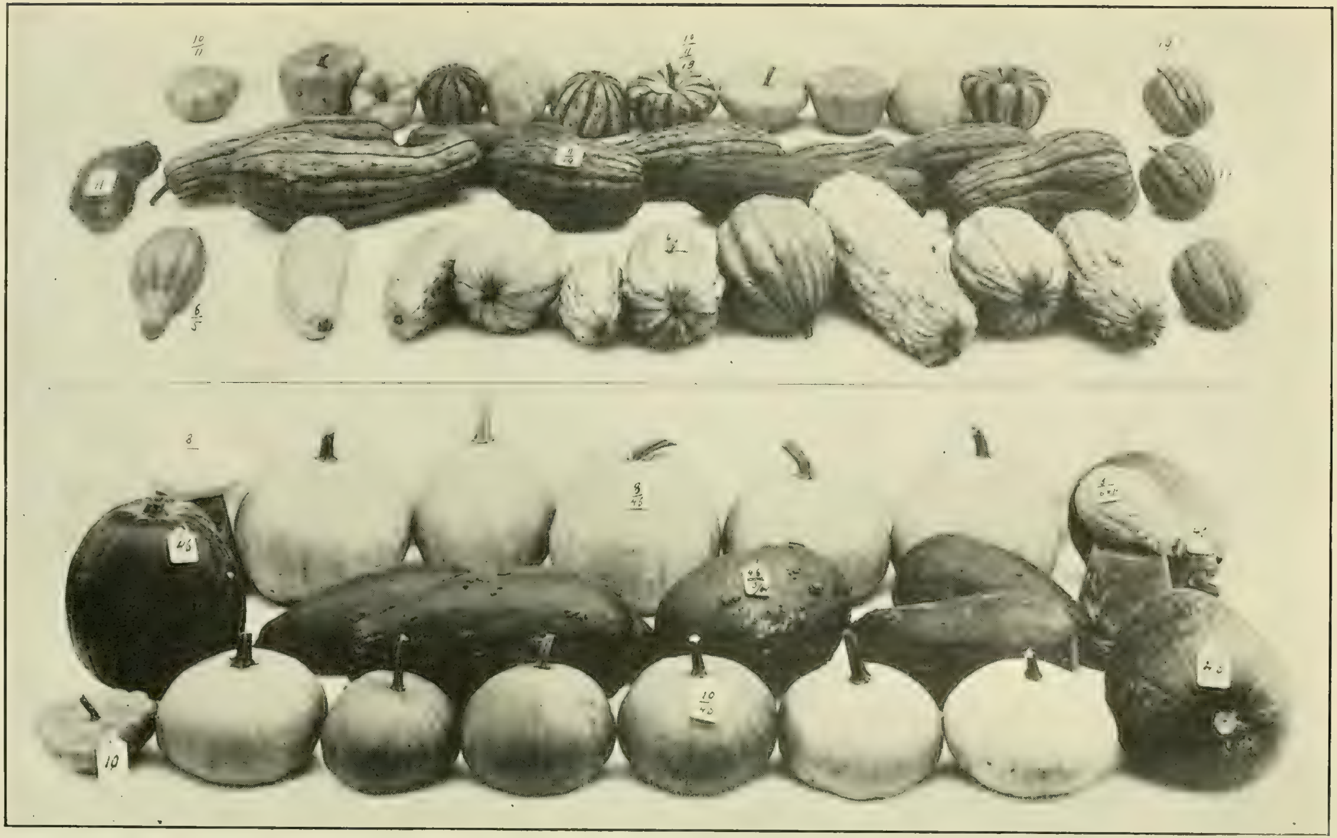

PLATE XXIV. *Summer-Winter Cucurbits.* Upper half shows crosses between summer and winter squashes (*C. Pepo*); lower half shows crosses between summer squashes and pumpkins.

several contrasting qualities: Squash and pumpkin, small and very large fruit, very early and very late, bush and running, a flat scallop and an oval form; finally, white surface and yellow surface. Its fruits began to form only three days later than the "Early Bush" and developed into large, cream-colored, pear-shaped fruits. Some of these were even larger than the pumpkin and their flesh thicker. When tested as a squash, it proved inferior but, as a pumpkin, it was fine. Their further value is earliness, being at least two weeks earlier than other pumpkins, The bush plant produced about two fruits. (Plate XXIV).

"Mammoth White Scallop-Field Pumpkin" (10/46). It is a similar cross to that described above, (8/46), with the size of fruit smaller. Its color varied from cream to yellow. The plant was bushy, producing two to three fruits and of good quality. (Plate XXIV).

"Field Pumpkin-Yellow Crookneck-Long Island-Strickler's Summer" (46///5/6//11). This cross differs from the preceding two in that the male parent was the pumpkin instead of the squash. The summer squash was a cross in itself, a small warted "jug." When a pumpkin was bred upon it, a surprisingly large offspring resulted, retaining a suggestion of the "jug" and yet appearing as a pumpkin more strongly than the two preceding crosses. This, however, has warts transmitted from the mother. The color is yellow like the pumpkin parent, and the fruit longer than that parent. The quality is considered fine. There were about two fruits to the bushy plant, and reached table maturity much earlier than the ordinary pumpkins. (Plate XXIV).

A GENERAL OBSERVATION ON BLENDS IN SQUASHES.

Outside of the summary given on page 262, it can be stated from all our blends that in the majority of cases there is no uniformity in shape, color and wartiness, and the variability is often very great, ranging from one parent to the other. A careful study was given in the arrangement of intergrading types in order to determine whether any given type takes the lead in number, and it showed without any exception that no particular type has a majority, it proved the variability to be so gradual that it was difficult to arrange them into distinct types. The gradation from one parent to the other may be of different degrees, that is to say, it may start from one parent and not quite approach the other, or it may reach directly to the other. But in every case the variability is gradual.

COMMERCIAL VARIETIES ADDED IN 1908.

No. 55. *"Mexican Pumpkin."* This is a large pear-shaped fruit with a mottled surface on a light background. The flesh is 4 cms. thick. The fruit matured late, there being but one or two fruits to a plant. The fruit is over a foot long.

No. 56. *"Chinese."* The fruits are long and medium large. The color is dark green or striped, giving the exact appearance of No. 41 grown last year. The difference, however, is in the appearance of the seeds, which are curiously marked like the appearance of Chinese letters.

No. 57. *"Farr's Benning White Bush."* A white scalloped fruit, in all respects similar to "Early Bush" (8).

No. 58. *"Porto Rican Black."* A medium-sized flat fruit. The surface is dark green and finely-grained and the flesh is orange, 3 cms. thick, and the vines exceedingly long.

No. 59. *"Porto Rican White."* The fruit is similar to No. 58 except that its surface is comparatively smooth. Both No. 58 and No. 59 are entirely too late, having barely time enough to mature the first fruit before frost.

No. 60. *"Prolific Marrow."* The plants failed to develop fruits.

No. 61. *"Japanese Pie Pumpkin."* A bottle-shaped fruit of medium size. It has peculiar ridges radiating from the stalk and half way down the fruit. The flesh is yellow, about 3 cms. thick. The fruit is about ten inches long.

No. 62. *"Sandwich Island Pumpkin."* This is a large, oval-shaped fruit with a deeply corrugated surface of a dark green color. It is about 15 inches long with a long fruit stalk; the flesh is about 3.5 cms. thick.

No. 63. *"Tennessee Sweet Potato Pumpkin."* This is an early fruit, of an attractive pear shape. The surface is white with a fine network of green. The fruit is over a foot long and its flesh about 3 cms. thick.

No. 64. *"Zuccotte."* The bushy plants were thrifty with huge leaves and produced fruits nearly three feet long and curved near the stalk end. The surface is dark green with light yellow stripes. Its flesh is only 2 cms. thick belonging to the class of vegetable marrows.

No. 65. "*Zucctuni.*" This is a gourd of immense size, three to four feet long, slightly bent or much curved, and of grayish color.

GENERAL OBSERVATIONS ON SUMMER SQUASHES.

1. Poor soil has no effect upon shape, color and smoothness or wartiness of fruit; it, however, reduces considerably the size of plant, leaf, flower and fruit; the flowering stage begins much later.
2. In crosses, flowers fertilize within the plant quite readily.
3. The number of fruits per plant depends considerably (varying from one to four or five) upon the number of plants in the hill.

EXPERIMENTS WITH PEAS.

In this, the third year of the experiments with peas, the work has been in particular the study of the blend plants in their various characteristics as compared with the parental varieties.

The following is a list of the commercial sorts employed and the record number of each:

1. "Abundance."
2. "Alaska."
3. "Alpha."
4. "American Wonder."
5. "Black-Eyed Marrowfat."
6. "Champion of England."
7. "Daisy."
8. "Daniel O'Rourke."
9. "Duke of Albany."
10. "Duke of York."
11. "Dwarf Champion."
12. "Everbearing."
13. "Extra Early Exonian."
14. "First of All."
15. "Gradus."
16. "Gray Seed, Mammoth."
17. "Gregory Surprise."
18. "Heroine."
19. "Horsford's Market Garden."
20. "Melting Sugar."
21. "Nott's Excelsior."
22. "Philadelphia Extra Early."
23. "Premium Gem."
24. "Pride of the Market."
25. "Prince of Wales."
26. "Shropshire Hero."
27. "Sutton's Excelsior."
28. "Sutton's Satisfaction."
29. "Telegraph."
30. "Telephone."
31. "Thomas Laxton."
32. "Thorburn's Extra Early Market."
33. "White Marrowfat."
34. "Witham Wonder."
35. "Yorkshire Hero."
36. "Tom Thumb."
37. "Prosperity."
38. "Prolific Market."
39. "Ameer."
40. "Admiral."
41. "French Canner."
42. "Dwarf Gray-Seeded Sugar."
43. "Advancer."
44. "Alderman."
45. "Boston Unrivaled."
46. "British Wonder."
47. "English Wonder."
48. "First and Best."
49. "Glory."
50. "Gregory's Excelsior."
51. "Improved Senator."
52. "Improved Sugar Marrow."
53. "Juno."
54. "Mammoth Pod Sugar."
55. "Pedigree Extra Early."
56. "Stratagem."
57. "Sutton's Green Gem."
58. "Wax-Podded."
59. "William Hurst."

60. "Tall Butter Sugar."
61. "Blue Ribbon Chieftan."
62. "Canada Blue."
63. "Canada White."
64. "Early Morn."
65. "Early Prize."
66. "Edward VII."
67. "Gardener's Favorite."
68. "Large Marrowfat."
69. "Lightning."
70. "Mammoth Luscious Sugar."
71. "May Queen."
72. "Pilot."
73. "Rawson's Clipper."
74. "Rivenhall Wonder."
75. "Scotch Champion."
76. "Sherwood."
77. "Velocity."
78. "Bountiful."
79. "Edwin Becket."
80. "Maud S."
81. "Morning Star."
82. "Canadian Beauty."
83. "Early Britain."
84. "Golden Vine."
85. "Grass."
86. "Prussian Blue."
87. "Chick Pea."

In Plate XXV is shown a set of pea seeds with varietal numbers that are involved in the work reported upon in the following pages. Plate XXVI shows a similar set with the pod of each variety bearing its record number and five dry peas to its right, respectively.

NOTES UPON THE INITIAL GROWTH OF PEAS.

The average pea seed imbibes from 65 per cent. to 165 per cent. of its own weight of water in twenty-four hours, wrinkled peas imbibing faster and more than smooth peas. After one day the seed coat loosens and the radicle is elevated somewhat from the cotyledon.

In two days, the radicle is from one-half to one inch long and the plumule shows signs of elongation. The best position for the seed is when the radicle points directly downward and the plumule arches upward.

At the end of the third day the plumule is from one-eighth to three-quarters of an inch long. At the end of the fourth day the side roots start from the tap root and the latter has many root hairs. The elongation of the root shown by ink marks is most rapid at two inches back of the tip and with the young stem in the region of the first leaf. The first and second leaves are nearly alike in being only the stipules with a minute slender midrib, from the axils of which branches may start in later growth. The third leaf shows some indication of leaflets. The fourth leaf is quite normal with few leaflets and small tendrils.

At the end of one week the root system consists of the tap root, two to six inches long, and many side roots arranged in three rows. The root hairs cover zones upon the roots and expose much surface for absorption. The stem is three inches high and is quite green at the top where the oldest leaf holds up its tendrils as the highest parts while the tip of the stem is folded

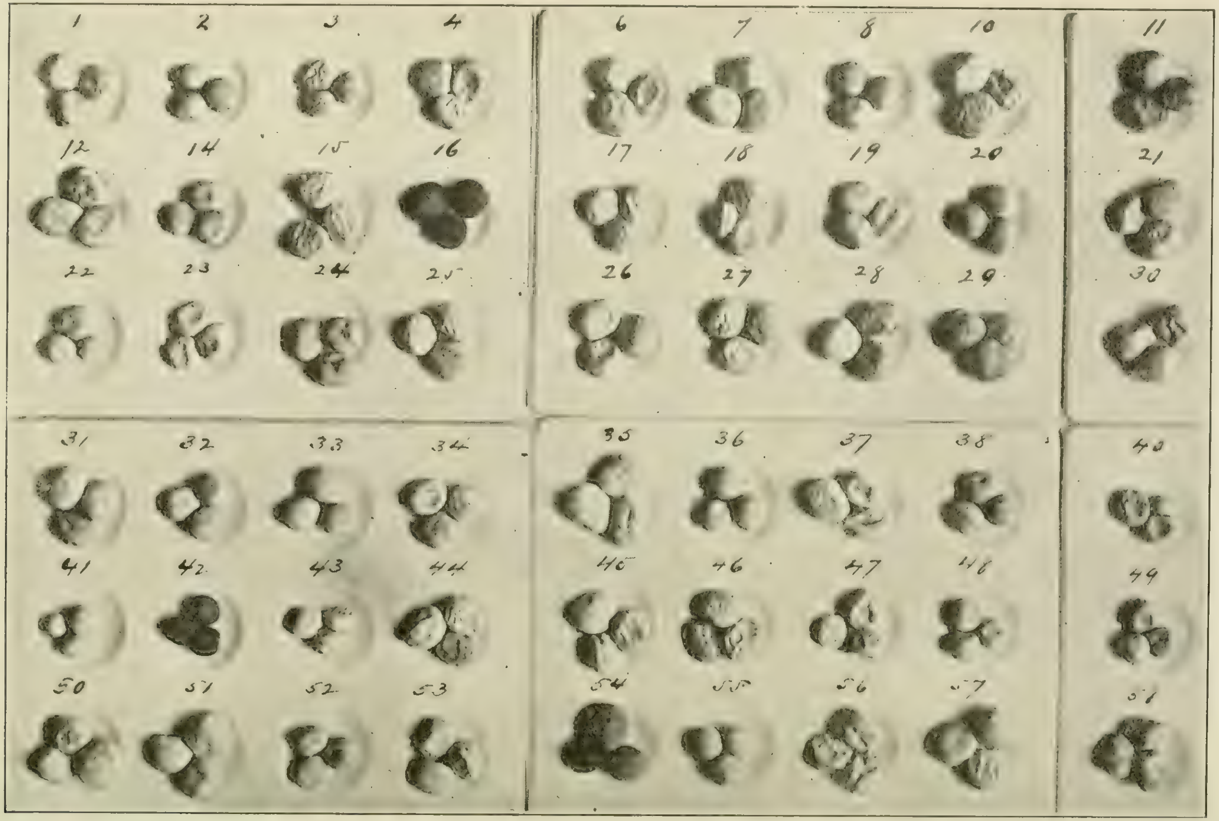
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Plate XXV. *Pea Seeds.* A set of pea seeds with varietal numbers attached.

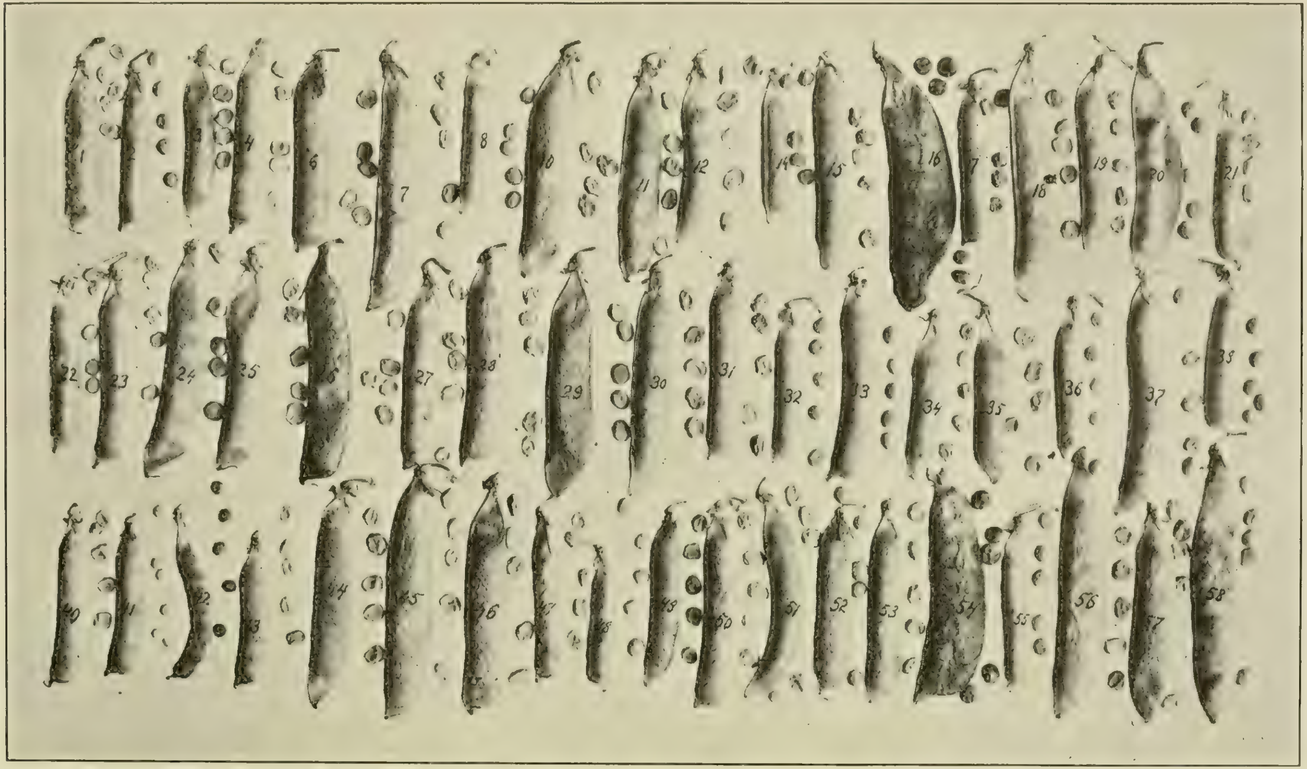
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Plate XXVI. *Pea Seeds and Pods.* A large number of varieties of peas are represented by pod and seeds. The variety record number is upon the pod and five dry seeds are shown to its right, respectively.

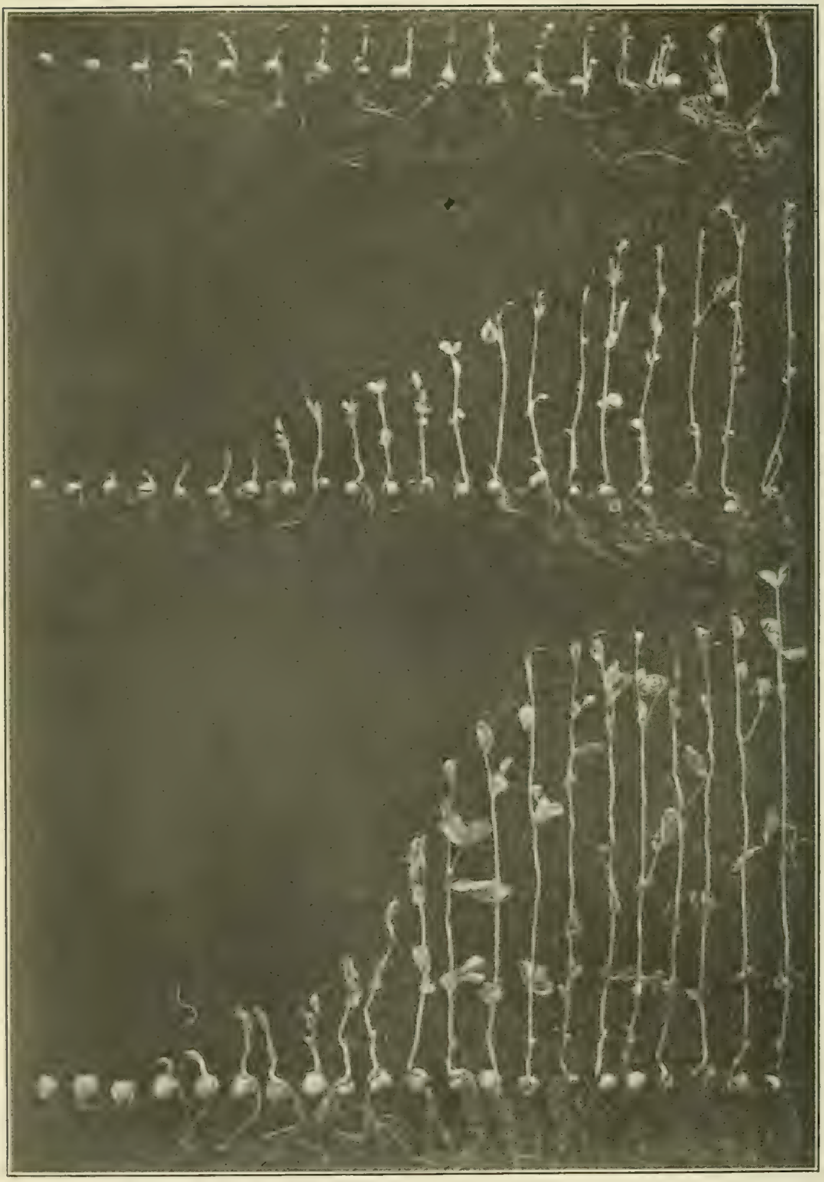

PLATE XXVII. *Pea Seedlings.* The upper row is from a dwarf set ("Tom Thumb"); the middle, the "French Canner," and the lower, a standard variety ("Gradus"). Each plant is one day older than the one to its left.

within its stipules. The cotyledons show that they have given up nearly all their food. By the use of ink markings, the stem is found to elongate throughout its whole length. Sections of the stem and root now will show all the structures well developed. At this stage, a branch from an axil of the first or second leaf may develop at the expense of the main stem which then ceases growth. Branches also start from the axils of the cotyledons.

The early development of pea seedlings is shown in Plate XXVII, where in the upper row seedlings of "Tom Thumb," a dwarf variety, are shown in daily succession from time of planting to seventeen days old; in the middle, the seedlings of "French Canner," a medium-sized variety, for twenty-one days, and in the lower part a corresponding series for twenty-one days for the "Gradus," a standard variety.

POINTS IN THE CLASSIFICATION OF PEAS.

Whole Plant.	Size: Standard (4-5½ ft.) Medium (2½-3½ ft.) Dwarf (1-2 ft.).
	Color: Light green; dark green.
	Length of internodes: Short (2-4 cm.); Medium (4½-6½ cm.); Long (7-9 cm.).
	Commencement of blooming from time of planting: 40-65 days.
	Maturity period from time of planting: 75-100 days.
Leaves.	Size: Large; small.
Leaflets.	Color: Light green; dark green.
	Size: Large; small.
	Form: Entire; serrate.
	Apex: Obtuse; acute.
	Number: Two; more than two per leaf.
Inflorescence:	Flower single; flowers in pairs.
Flower.	Size: Large; small.
	Color: White; pink.
	Position: Erect; drooping.
Fruit.	Size: Small (5-6½ cm.); Medium (7-8 cm.); Large (8½-11 cm.).
	Color: Green; green "wax."
	Form: Flat; round; inflated.
	Shape: Curved; straight.
	Apex: Sharp; blunt.
	Number per plant: Few (5); many (50).
Seeds.	Size: Small; medium; large.
	Color: Cream; green; brown.
	Form: Round; lenticular; drum; elongated.
	Surface: Smooth; dented; wrinkled.
	Weight: 2.5-9.0 gms. per 25 seeds.
	Number per pod: 4-8.
	Imbibition capacity: 65 per cent.-165 per cent. of its own weight during the first 24 hours.

A BIOMETRIC LIST OF FIFTY-SEVEN COMMERCIAL KINDS OF PEAS.

Station number of variety.	Age of plant in days at the beginning of flowering.	Height in feet of mature plant.	Number of pods per plant.	Average length in centimeters of pod.	Form of pod.	Apex of pod.	Size of seed.	Weight in grams of 25 seeds.	Form of seed.	Surface of seed.	Color of seed.	Imbibition capacity of seed after 24 hours.	Length in centimeters of plumule after five days.
1	56	3	20–30	7.5	Straight	Blunt	Medium	6.1	Drum	Wrinkled	Green	133%	2.0
2	44	2½–3	10–12	7.5	Straight	Blunt	Small	5.0	Round	Smooth	Green	106	2.0
3	44	3 –3½	12–15	7.25	Straight	Blunt	Small	4.7	Elongated	Wrinkled	Green	149	1.5
4	44	1 –1½	8–10	7.0	Straight	Blunt	Medium	6.8	Drum	Wrinkled	Mixed	124	1.5
5	63	4	30	7.0	Straight	Blunt	Medium	8.3	Round	Smooth	Cream	90	1.0
6	62	4 –5	25–35	8.5	Straight	Blunt	Large	7.7	Elongated	Wrinkled	Mixed	143	1.5
7	60	2 –2½	15–20	10.0	Straight	Sharp	Medium	6.0	Elongated	Wrinkled	Mixed	147	1.0
8	44	3 –3½	10–12	6.5	Straight	Blunt	Small	4.5	Round	Smooth	Cream	109	1.0
10	53	3 –4	10–15	9.0	Straight	Blunt	Medium	6.8	Elongated	Wrinkled	Mixed	159	1.0
11	56	2 –3	12–15	8.5	Straight	Blunt	Medium	6.8	Elongated	Wrinkled	Green	146	2.0
12	56	2½–3½	20–35	7.5	Curved	Sharp	Large	7.1	Elongated	Wrinkled	Green	163	1.0
14	44	3 –4	10–15	6.25	Straight	Blunt	Small	5.3	Round	Smooth	Cream	115	1.0
15	44	3½–4	8–10	9.25	Straight	Sharp	Large	8.8	Elongated	Wrinkled	Cream	146	1.5
16	46	4 –5	15–20	10.75	Curved	Blunt	Medium	6.7	Lenticular	Wrinkled	Brown	106	2.5
17	44	3 –3½	6–8	7.0	Straight	Blunt	Medium	7.0	Elongated	Wrinkled	Green	67	1.5
18	60	2½–3	20–30	9.75	Curved	Sharp	Medium	6.0	Elongated	Wrinkled	Mixed	157	2.0
19	56	3	20–35	7.5	Straight	Blunt	Medium	5.1	Elongated	Wrinkled	Green	155	1.5
20	60	3 –4	20–30	8.75	Curved	Blunt	Medium	5.6	Lenticular	Wrinkled	Cream	109	1.5
21	44	1½–2	8–10	7.25	Straight	Blunt	Medium	7.1	Drum	Wrinkled	Mixed	125	2.0
22	44	2 –2½	8–10	6.75	Straight	Blunt	Medium	4.7	Round	Smooth	Cream	117	0.5
23	48	1½–2	10–12	7.75	Curved	Blunt	Medium	6.0	Drum	Wrinkled	Green	143	0.5
24	60	2 –3	15–20	9.5	Curved	Sharp	Medium	7.5	Elongated	Wrinkled	Green	100	1.0
25	56	3 –3½	10–15	8.75	Curved	Blunt	Large	6.8	Elongated	Wrinkled	Cream	156	1.0
26	56	2½–3	12–15	10.25	Curved	Blunt	Medium	6.7	Elongated	Wrinkled	Mixed	154	1.0
27	48	2	10–15	8.5	Straight	Blunt	Large	6.7	Elongated	Wrinkled	Mixed	141	1.0
28	56	2½–3	10–15	8.5	Curved	Blunt	Large	7.2	Elongated	Wrinkled	Mixed	150	1.5
29	56	3½–4½	15–20	9.75	Straight	Sharp	Large	8.4	Elongated	Wrinkled	Mixed	106	1.0
30	56	4½–5½	12–15	10.0	Straight	Sharp	Medium	7.6	Elongated	Wrinkled	Green	157	1.5

A BIOMETRIC LIST OF FIFTY-SEVEN COMMERCIAL KINDS OF PEAS—(continued).

Station number of variety.	Age of plant in days at the beginning of flowering.	Height in feet of mature plant.	Number of pods per plant.	Average length in centimeters of pod.	Form of pod.	Apex of pod.	Size of seed.	Weight in grams of 25 seeds.	Form of seed.	Surface of seed.	Color of seed.	Imbibition capacity of seed after 24 hours	Length in centimeters of plumule after five days.
31	48	3 -4	10-12	7.75	Straight	Blunt	Medium	6.6	Elongated	Wrinkled	Cream	165%	1.0
32	48	3	6-8	6.75	Straight	Blunt	Medium	5.2	Round	Smooth	Cream	111	1.0
33	60	4½-5	10-20	8.5	Curved	Blunt	Medium	7.2	Round	Smooth	Cream	90	0.5
34	48	1½-2	10-15	7.0	Curved	Sharp	Small	3.9	Drum	Wrinkled	Green	144	1.0
35	56	2½-3	20-30	7.0	Straight	Sharp	Large	7.5	Drum	Wrinkled	Mixed	147	1.0
36	44	1 -1½	10-15	7.0	Straight	Blunt	Small	5.5	Round	Smooth	Cream	100	1.5
37	48	3 -3½	8-10	9.75	Straight	Sharp	Large	8.3	Elongated	Wrinkled	Cream	123	1.5
38	53	3 -3½	8-10	6.75	Straight	Blunt	Medium	5.5	Round	Smooth	Cream	115	1.0
40	60	4 -5	10-12	7.0	Curved	Blunt	Medium	4.1	Elongated	Wrinkled	Cream	163	1.5
41	60	3½-4	10-12	6.25	Curved	Blunt	Small	2.8	Round	Smooth	Cream	125	1.5
42	46	2½-3	10-15	8.25	Curved	Blunt	Small	3.6	Round	Smooth	Brown	89	2.5
43	53	2 -3	10-12	6.75	Curved	Blunt	Medium	4.5	Elongated	Wrinkled	Mixed	155	1.5
44	56	4½-5	10-15	8.5	Straight	Sharp	Large	7.1	Elongated	Wrinkled	Mixed	158	2.0
45	56	3½-4½	10-12	10.75	Straight	Sharp	Large	7.9	Elongated	Wrinkled	Mixed	150	1.5
46	54	1½-2	8-10	8.5	Straight	Blunt	Large	6.7	Elongated	Wrinkled	Mixed	157	1.0
47	54	1½	10-12	7.25	Curved	Blunt	Medium	4.8	Drum	Wrinkled	Mixed	165	1.5
48	44	3 -3½	10-12	6.25	Straight	Blunt	Small	6.1	Round	Smooth	Cream	97	2.0
49	60	3½-4	10-12	7.5	Curved	Sharp	Small	4.5	Drum	Wrinkled	Green	150	1.0
50	48	1½-2	6-8	8.25	Straight	Blunt	Large	7.1	Elongated	Wrinkled	Mixed	151	2.0
51	56	3	10-15	8.75	Curved	Sharp	Medium	8.6	Elongated	Wrinkled	Mixed	158	1.0
52	60	5	10-15	8.25	Straight	Blunt	Medium	6.8	Round	Smooth	Cream	103	1.0
53	60	2½-3	10-15	8.0	Straight	Blunt	Medium	5.5	Elongated	Wrinkled	Cream	145	1.0
54	46	4 -5	10-15	9.5	Curved	Blunt	Medium	7.7	Lenticular	Wrinkled	Brown	109	2.0
55	48	3 -3½	8-10	6.75	Straight	Blunt	Medium	6.3	Round	Smooth	Cream	105	1.5
56	56	2 -2½	10-12	9.75	Straight	Sharp	Large	7.5	Elongated	Wrinkled	Mixed	137	2.0
57	50	1½	8-10	8.75	Straight	Sharp	Medium	7.2	Elongated	Wrinkled	Mixed	147	1.5
58	63	5	20-30	10.5	Straight	Sharp	Medium	7.5	Elongated	Wrinkled	Cream	113	2.5
59	44	2	10	7.0	Straight	Blunt	Medium	6.7	Drum	Wrinkled	Mixed	140	1.0
60	63	4	15	6.25	Curved	Sharp	Medium	6.2	Round	Smooth	Cream	93	1.0

A METHOD FOR STUDYING CORRELATIONS OF PEAS.

The method used in the study of correlations among peas was as follows:

1. A fair number of established commercial varieties was grown.

2. A number of characteristics not common to all, or not of the same degree in all, were tabulated. (See Biometric list of Commercial peas).

3. The tabulated characteristics were placed together on a separate card for each variety.

4. The cards were collected into groups according to natural or artificial divisions of a characteristic, as for instance, colors, range in height, etc. (It is necessary to emphasize the importance of having each division represented by a fair number of the varieties, depending upon the characteristic and the total number of varieties under observation). With one or two exceptions, no division in the peas contained less than one-fifth the total number of varieties.

5. For each division of a characteristic a table of the extremes of variability was made out for each of the remaining characteristics in that division (See Correlation table). For example, a character, as height of mature plant, is divided into four sizes, namely, (1) 1-2½ feet; (2) 3 feet; (3) 3½-4 feet, and (4) 4½-5½ feet. Under each of these four divisions are given the extremes of the remaining characters associated with that size.

6. After the divisions of all the characteristics are thus tabulated, any existing correlation among them can be found by comparing the extremes of any characteristic with the corresponding divisions of another characteristic; thus, the first statement in correlations, that range in height increases with the maturity of plant but decreases towards the end, was drawn from the comparison of the extremes in heights corresponding to the divisions of maturity period of plant.

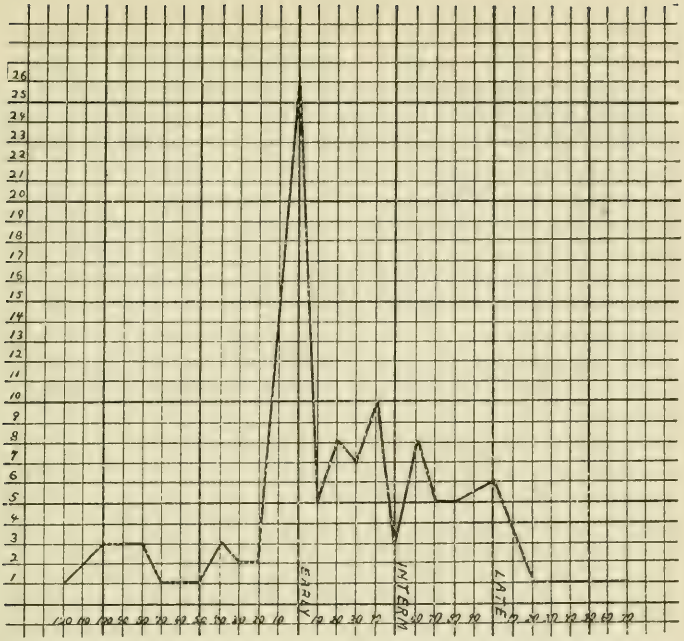

Figure 3. *Biometric Curve* in relation to maturity period in breeding peas.

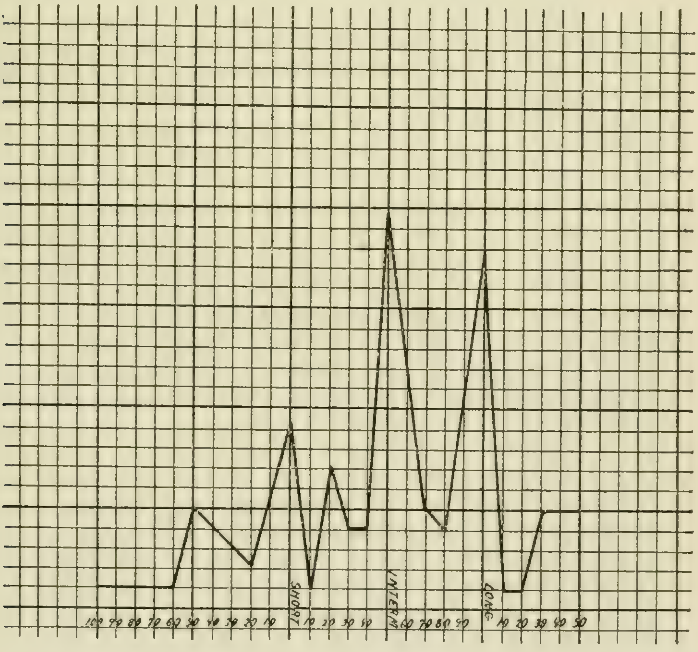

Figure 4. *Biometric Curve* in relation to height of peas in breeding.

Correlation Table from Previous Biometric List.

Comparing characteristics.	Division of characteristics.	Age of plant at beginning of flowering.	Height in feet of mature plant.	Number of pods per plant.	Average length in centimeters of pod.	Form of pod.	Apex of pod.
Age of plant at beginning of blossoming time..........	44	.....	1 –3½	6–15	6.25– 7.5	Straight........	Blunt.......
	46–50	.....	1½–5	6–20	6.75–10.75	Straight, curved.	Blunt, sharp.
	53–56	.....	1½–5½	8–35	6.75–10.75	Straight, curved.	Blunt, sharp.
	60–63	.....	2 –5	10–30	6.00–10.50	Straight, curved.	Blunt, sharp.
Height of mature plant............	1 –2½	44–60	....	8–20	6.75–10.0	Straight, curved.	Blunt, sharp.
	3	44–60	....	6–35	6.75–10.25	Straight, curved.	Blunt, sharp.
	3½–4	44–63	....	6–35	6.25–10.75	Straight, curved.	Blunt, sharp.
	4½–5½	46–60	....	10–35	7.0 –10.75	Straight, curved.	Blunt, sharp.
Number of pods per plant............	6–10	44–54	1½–3½	.....	6.75– 9.75	Straight.	Blunt, sharp.
	10–12	44–60	1½–4½	.....	6.25–10.75	Straight, curved.	Blunt, sharp.
	12–15	44–60	1½–5	.....	6.25–10.75	Straight, curved.	Blunt, sharp.
	15–30	56–63	2½–5½	.....	7.0 –10.5	Straight, curved.	Blunt, sharp.
Average length of pod..............	6.25– 7.0	44–63	1 –5	6–30	....	Straight, curved.	Blunt, sharp.
	7.25– 8.0	56–60	1½–4	8–35	....	Straight, curved.	Blunt, sharp.
	8.25– 9.0	46–62	1½–5	6–35	....	Straight, curved.	Blunt, sharp.
	9.25–10.75	46–63	2 –5½	8–30	....	Straight, curved.	Blunt, sharp.
Form of pod......	Straight...	44–63	1 –5½	6–35	6.25–10.75	....	Blunt, sharp.
	Curved....	46–63	1½–5	10–35	6.25–10.75	....	Blunt, sharp.
Apex of pod.	Blunt.....	44–63	1 –5	6–35	6.25–10.75	Straight, curved.	....
	Sharp.	46–63	1½–5½	8–35	6.25–10.75	Straight, curved.	....
Size of seed.......	Small.	44–60	1 –4	10–15	6.25– 8.25	Straight, curved.	Blunt, sharp.
	Medium...	44–63	1 –5½	6–35	6.25–10.75	Straight, curved.	Blunt, sharp.
	Large.....	46–62	1½–5	6–35	7.0 –10.75	Straight, curved.	Blunt, sharp.
Weight per 25 seeds	2.8–5.1	44–60	1½–5	8–35	6.25– 8.25	Straight, curved.	Blunt, sharp.
	5.2–6.3	44–63	1 –4	6–30	6.25–10.0	Straight, curved.	Blunt, sharp.
	6.6–7.2	44–60	1 –5	6–35	7.0 –10.75	Straight, curved.	Blunt, sharp.
	7.5–8.8	46–63	2 –5½	8–35	7.0 –10.75	Straight, curved	Blunt, sharp.
Form of seed......	Drum.	44–56	1½–3½	8–30	7.0 – 7.75	Straight, curved.	Blunt, sharp.
	Round. ...	44–63	1½–5	6–30	6.25– 8.5	Straight, curved.	Blunt, sharp.
	Elongated .	44–63	1½–5	6–35	6.75–10.75	Straight, curved.	Blunt, sharp.
	Lenticular.	46–62	3 –5	10–30	8.5 –10.75	Curved	Blunt.......
Color of seed.	Green.....	44–60	1½–4½	6–35	7.0 – 9.75	Straight, curved.	Blunt, sharp.
	Cream....	44–63	1½–5	6–30	6.25–10.5	Straight, curved.	Blunt, sharp.
	Mixed.....	44–62	1½–5	6–35	6.75–10.25	Straight, curved.	Blunt, sharp.
	Brown....	46	2½–5	10–20	8.25–10.75	Curved	Blunt, sharp.
Imbibition capacity of seed after 24 hours.	67–105	44–63	1 –5	6–30	6.25– 9.5	Straight, curved.	Blunt, sharp.
	106–117	44–63	2 –5½	6–30	6.25–10.75	Straight, curved.	Blunt, sharp.
	123–144	44–62	1 –5	8–35	6.25– 9.75	Straight, curved.	Blunt, sharp.
	145–154	44–60	1½–4½	6–30	7.0 –10.75	Straight, curved.	Blunt, sharp.
	155–165	48–60	1½–5½	8–35	6.75–10.0	Straight, curved.	Blunt, sharp.

CORRELATION TABLE FROM PREVIOUS BIOMETRIC LIST.

Size of seed.	Weight in grams of 25 seeds.	Form of seed.	Color of seed.	Imbibition capacity of seed after 24 hours.
				%
Small, med.,	4.7–7.1	Drum, round, elongated	Green, cream, mixed	67–149
Small, med., large	3.6–8.8	Drum, round, elongated, lenticular	Green, cream, mixed, brown	89–165
Medium, large	4.5–8.6	Drum, round, elongated	Green, cream, mixed	106–165
Small, med., large	2.8–7.7	Round, elongated	Green, cream, mixed	90–163
Small, med., large	3.9–7.5	Drum, round, elongated	Green, cream, mixed	100–165
Small, med., large	3.6–7.5	Drum, round, elongated, lenticular	Green, cream, mixed, brown	89–158
Small, med., large	2.8–8.8	Drum, round, elongated, lenticular	Green, cream, mixed	67–165
Medium, large	6.8–7.7	Round, elongated, lenticular	Green, cream, mixed, brown	90–163
Medium, large	4.7–8.8	Drum, round, elongated	Green, cream, mixed	67–157
Small, med., large	2.8–7.9	Drum, round, elongated	Green, cream, mixed	97–165
Small, med., large	3.6–8.6	Drum, round, elongated, lenticular	Green, cream, mixed, brown	89–159
Medium, large	5.1–8.4	Drum, round, elongated, lenticular	Green, cream, mixed, brown.	90–163
Small, med., large	2.8–8.3	Drum, round, elongated	Green, cream, mixed	67–163
Small, med., large	4.5–7.1	Drum, round, elongated	Green, cream, mixed	106–165
Small, med., large	3.6–8.6	Drum, round, elongated, lenticular	Green, cream, mixed, brown	89–159
Medium, large	6.0–8.8	Elongated, lenticular	Green, cream, mixed, brown.	100–157
Small, med., large	4.5–8.8	Drum, round, elongated	Green, cream, mixed	67–165
Small, med., large	2.8–8.6	Drum, round, elongated, lenticular	Green, cream, mixed, brown	89–165
Small, med., large	2.8–8.3	Drum, round, elongated, lenticular	Green, cream, mixed, brown	67–165
Small, med., large	3.9–8.8	Drum, round, elongated	Green, cream, mixed	93–163
....	2.8–6.1	Drum, round, elongated	Green, cream	89–115
....	4.1–8.6	Drum, round, elongated, lenticular	Green, cream, mixed, brown	67–165
....	6.7–8.8	Drum, elongated	Green, cream, mixed	106–163
Small, medium	....	Drum, round, elongated	Green, cream, mixed	89–165
Small, medium	....	Drum, round, elongated, lenticular	Green, cream, mixed	93–157
Medium, large	....	Drum, round, elongated, lenticular	Green, cream, mixed, brown	67–165
Medium, large	....	Drum, round, elongated, lenticular	Green, cream, mixed, brown	90–158
Small, med., large	3.9–7.5	....	Green, mixed	124–165
Small, medium	2.8–8.3	....	Green, cream, brown	89–125
Medium, large	4.1–8.8	....	Green, cream, mixed	67–165
Medium	5.6–7.7	....	Brown	106–14
Small, med., large	3.9–8.4	Drum, round, elongated	....	100–157
Small, med., large	2.8–8.8	Round, elongated, lenticular	....	90–165
Medium, large	4.5–8.6	Drum, elongated, lenticular	....	67–165
Small, medium	3.6–7.7	Round, lenticular	....	89–109
Small, medium	3.6–8.3	Round, elongated	Green, cream, mixed, brown	....
Small, med., large	4.5–8.4	Round, elongated, lenticular	Green, cream, mixed, brown.	....
Small, med., large	2.8–8.3	Drum, round, elongated	Green, cream, mixed	....
Small, med., large	4.5–8.8	Drum, elongated	Green, cream, mixed	....
Medium, large	4.1–8.6	Drum, elongated	Green cream, mixed	....

OBSERVATIONS DRAWN FROM A STUDY OF FIFTY-SEVEN VARIETIES.

REGARDING THE WHOLE PLANT.

Height increases with length of maturity period.
True standards are associated with large seed.
True standards are associated with the absence of "drum" seed.
Earliness is associated with straight pods.
Earliness is associated with blunt apex of pod.
Lateness is associated with the absence of "drum" seed.

CONCERNING THE POD.

Number increases with that of maturity period of plant.
Number increases with that of height of plant.
Size increases with the height of plant.
Size increases with number of pods.
Size increases with the maturity period of plant.
Small number is associated with the straight form.
Large size is associated with large seed.
Large size is associated with the absence of "drum" seed.
Large size is associated with the absence of round seed.

OF THE SEED ONLY.

"Drum" form is associated with early maturing plants.
"Drum" form is associated with dwarf plants.
"Drum" form is associated with small seeds.
Imbibition capacity is associated with size but not with weight.
Good imbibition is associated with the absence of round form.

ASSOCIATIONS OBSERVED WITHOUT THE AID OF THE TABLE.

Imbibition capacity of seed is associated with wrinkles.

Brown seed is associated with purple flowers and axils.

Vigorous growth of seeding during the first few days is associated with edible pods.

Dark color of pods in alcohol indicate edible quality.

The existence of distinct green and cream-colored seed, as varietal characters, requires further study. The main obstacle to the decision is the existence of a large number of established varieties with mixed distinct green and cream seeds.

GENERAL OBSERVATIONS ON PEAS.

In the same variety, branching plants have longer internodes.
The oldest branch is not necessarily at the base of the plant.
The more plants there are to a hill, the less they branch.
Late varieties mature pods more gradually than early varieties.
The first pods do not necessarily appear lowest upon the plant.
In branching plants the main stem bears the first pods.

The only way to determine correctly the number of pods per plant in a variety is to take an average of a large number of plants, since some bear two or three times as many as others.

Pea blossoms diminish in size as maturity of plant approaches.

Only the last blossoms shed their pollen before corolla opens.

Last blossoms have poor pollen and pistils; pods may form but they are seedless and as large as those with seed.

The normal color of anthers is yellow, but occasionally they are red and show no pollen.

A STUDY OF UNA FROM THE "BLEND" PROGENY.

About two hundred blends, representing different combinations, were biometrically studied together with their parents. A summary of the extensive tables computed is given below, with a graphic representation, Figure 2.

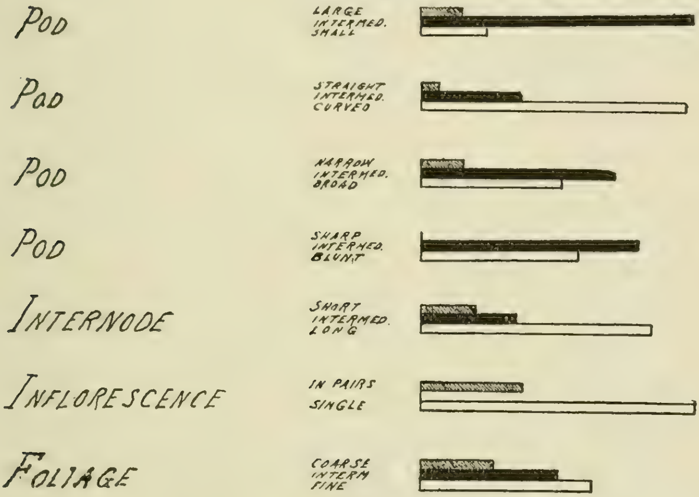

Figure 2. *Pea Crosses.* Relative number of blends showing resemblance to either parent.

BLENDS SHOWING RESEMBLANCE TO EITHER PARENT.

Combination.	Character.	1 per cent.	Intermediate.	Character.	2 per cent.	Number of Blends.
Small and large pod	Small	17	72	Large	11	48
Straight and curved pod	Straight	4	26	Curved	70	22
Narrow and broad pod	Narrow	11	52	Broad	37	26
Blunt and sharp apex	Blunt	42	58	Sharp	0	32
Inflated and close pod	Inflated	0	..	Close	100	12
Wax and green pod	Wax	0	..	Green	100	30
Edible and non-edible pod	Edible	0	100	Non-edible	0	19
Long and short internode	Long	61	25	Short	14	28
Fine and coarse leaf	Fine	45	36	Coarse	19	11
Flower: pair and single	Pair	27	0	Single	73	15
Flower: pink and white	Pink	100	0	White	0	13
Early and late blooms	Early	48	45	Late	7	114
Short and tall plant	Short	18	54	Tall	28	112
Few and many pods	Few	46	8	Many	46	114

A STUDY OF EARLINESS AND LATENESS.

The Biometric curve constructed on Early and Late groups (Fig. 3) shows that in period of maturity:

1. The greatest frequency distribution in blends between an early and a late parent resembles the early parent, or in other words, when an early variety is crossed with a late variety, the offspring stands the greatest chance of being like the early parent.
2. Of the blends intermediate to the two parents, the greater frequency distribution is more toward the early parent, that is, when an offspring from an early and late parent, is intermediate, it stands the greater chance of resembling the early parent more than the late parent.
3. There is an aggravation on either side but more in number and degree on the early side; in other words, blends may be earlier than the early parent, or later than the late parent but the former chance is greater.

Conclusion: In the blend generation, earliness is a stronger character than lateness.

A STUDY OF SIZES OF PLANTS.

The Biometric curve constructed on Short and Tall groups (Fig. 4) shows that in height:

1. The greatest frequency distribution in blends between parents of different heights is intermediate to the parents; in other words, when a short plant is crossed with a tall plant, the offspring stands the greatest chance to be intermediate in height to both parents.
2. Of the blends resembling the parents, the greatest frequency distribution is like the tall parent, that is, there is a much greater chance for the offspring to be like its tall parent than its short parent.
3. There is an aggravation on either side but more in number on the tall side, or in other words, blends may be taller than the tall plant or shorter than the short parent but the former chance is greater.

Conclusion: Plants in the blend generation have the greatest tendency to be intermediate to both parents, and a strong tendency to be like the tall parent.

GENERAL SUMMARY UPON UNA AS EXPRESSED IN BLEND PROGENY.

1. Small and large pods show sympathetic una.

2. Curved and straight pods show more or less of sympathetic una. The curved form has the stronger influence.

3. Narrow and broad pods show sympathetic una.

4. Blunt apex and sharp apex show sympathetic una.

5. Close and inflated pods show antagonistic una; the close is dominant.

6. Green and wax-colored pods show antagonistic una; the green is dominant.

7. Edible and non-edible pods show sympathetic una.

8. Long and short internodes show sympathetic una but the long has a much stronger influence.

9. Fine and coarse leaf show sympathetic una.

10. Pink and white flower show antagonistic una; the pink is dominant.

11. Earliness and lateness show sympathetic una but earliness has a much stronger influence.

12. Short and tall plant, show sympathetic una; the tall has the stronger influence.

13. Few and many pods show sympathetic una.

RECIPROCAL CROSSES.

Cross	Maturity period.			Height of plant.			Number of pods per plant.			Relation of reciprocals.			Predominant parent.		
	Male parent.	Blend.	Female parent.	Male parent.	Blend.	Female parent.	Male parent.	Blend.	Female parent.	Maturity period.	Height of plant.	Number of pods per plant.	Maturity period.	Height of plant.	Number of pods per plant.
3/32	87	85	81	3	3	2½	15	10	10	a.	a.	d.[2]	—	—	f.[3]
32/3	81	85	87	2½	3	3	10	20	15						
4/23	83	80	86	1	1½	1½	10	10	15	a.	a.	d.	—	—	m.[4]
23/4	86	80	83	1½	1½	1	15	15	10						
8/22	77	77	80	3	2½	2	15	10	10	a.	d.	d.	—	f.	f.
22/8	80	77	77	2	3	3	10	15	15						
8/48	77	77	77	3	2	3	15	10	15	a.	a.	a.	—	—	s.[5]
48/8	77	77	77	3	2	3	15	6	15						
17/22	77	77	80	3	2½	2	10	10	10	a.	a.	d.	—	—	—
22/17	80	77	77	2	2½	3	10	10	10						
17/48	77	77	77	3	2½	3	10	6	15	a.	a.	d.	—	—	m.
48/17	77	77	77	3	2½	3	15	10	10						
21/23	86	80	80	1½	1	1½	15	10	10	a.	d.	d.	—	s.	f.
23/21	80	80	86	1½	1½	1½	10	15	15						
40/41	88	86	86	4½	3½	3½	15	35	15	d.	d.	d.	m.	m.	s.
41/40	86	85	88	3½	3	4½	15	30	15						
41/52	86	83	93	3½	3	4½	15	20	15	d.	d.	d.	f.	f.	s.
52/41	93	77	86	4½	2½	3½	15	10	15						
2/23	77	77	86	2½	3	1½	15	10	10	d.	d.	d.	f.	m.	m.
23/2	86	74	77	1½	2	2½	10	6	15						
16/41	93	85	86	4½	3	3½	20	10	15	d.	d.	d.	f.	f.	f.
41/16	86	89	93	3½	3½	4½	15	40	20						
18/41	93	85	86	2½	5	3½	30	15	15	d.	d.	d.	f.	f.	f.
41/18	86	88	93	3½	4	2½	15	30	30						
20/41	93	88	86	3½	4	3½	30	15	15	d.	d.	d.	m.	s.	f.
41/20	86	85	93	3½	3	3½	15	25	30						
36/48	81	77	77	1½	2	3½	20	20	15	a.	d.	d.	—	f.	m.
48/36	77	77	81	3½	1	1½	15	15	20						
41/42	86	89	86	3½	3½	2½	15	30	15	d.	d.	d.	s.	f.	s.
42/41	86	81	86	2½	4	3½	15	25	15						
41/58	86	85	98	3½	3	5½	15	30	25	d.	d.	d.	m.	m.	m.
58/41	98	91	86	5½	4	3½	25	35	15						

1. Alike.
2. Different.
3. Female.
4. Male.
5. Similar.

SUMMARY OF RECIPROCAL CROSSES.

	Reciprocals.		Differentiations when both parents are similar.	Dominant parent in dissimilar reciprocals.	
	Similar.	Dissimilar.		Male.	Female.
Maturity period	50 %	50 %	12 %	40 %	60 %
Height of plant	30 %	70 %	15 %	35 %	65 %
Prolificness	6 %	94 %	27 %	45 %	55 %

Observations: (1) A great majority of reciprocals are dissimilar. (2) The female parent seems to have a greater influence on the blend in period of maturity, height of plant and prolificness. (3) Blends may deviate in a unum even when the parents are similar in that unum; the deviation is greater the more the reciprocals tend to become dissimilar.

EXPERIMENT WITH SEEDS REGARDING THEIR POSITION IN THE POD.

In order to determine the relative quality of peas regarding their position in the pod, ten different varieties were selected for study. From each of the crosses, five pods were selected and from each pod one seed taken from the stem end, one from the middle and one from the tip end of the pod, thus giving five seeds from each position in each variety; each of which was grown with the following results:

Kind.	Position in pod.	Time of formation of pods.	Maturity period of plant (days).	Height of plant (feet).	Number of pods per plant.
2/41 (I)	stem end	earliest	81	2½	15
	middle	2nd early	83	4	20
	tip end	latest	85	3	25
14/5 (I)	stem end	latest	87	3	30
	middle	earliest	83	4	20
	tip end	2nd early	85	3	30
21/41 (I)	stem end	latest	86	1½	35
	middle	2nd early	84	1	25
	tip end	earliest	85	2	50
36/4 (I)	stem end	latest	91	3	25
	middle	earliest	88	3½	35
	tip end	2nd early	93	3	45
36/30 (I)	stem end	2nd early	91	4	30
	middle	earliest	89	3	25
	tip end	latest	86	3	25

Kind.	Position in pod.	Time of formation of pods.	Maturity period of plant (days).	Height of plant (feet).	Number of pods per plant.
40/41 (I)	stem end	latest	89	3	10
	middle	earliest	86	3	10
	tip end	2nd early	81	2½	5
41/4 (I)	stem end	2nd early	87	4	50
	middle	earliest	86	3	30
	tip end	latest	88	2	40
41/4 (II)	stem end	2nd early	93	3½	55
	middle	earliest	88	3	30
	tip end	latest	90	2½	70
41/36 (I)	stem end	latest	85	3½	30
	middle	earliest	83	3	20
	tip end	2nd early	84	3½	25
54/58 (I)	stem end	latest	91	3½	20
	middle	earliest	89	3	15
	tip end	2nd early	87	3	15

SUMMARY.

Position of seed in the pod.	Time of formation of pods.			Maturity period of plant.			Height of plant.			Number of pods per plant.		
	Earliest.	Second early.	Latest.	Shortest.	Intermediate.	Longest.	Short.	Intermediate.	Tall.	Least.	Intermediate.	Greatest.
Stem end.	10%	30%	60%	10%	20%	70%	10%	50%	40%	20%	40%	40%
Middle.	80%	20%	.....	60%	40%	.....	20%	50%	30%	50%	50%	.....
Tip end.	10%	50%	40%	30%	40%	30%	30%	60%	10%	10%	50%	40%

Observations: (1) Plants from seed from the middle of pod generally bear earlier than seed from the stem or tip ends; plants from seed from the stem end are the latest bearers. (2) Plants from seed from the stem end of pod generally have a longer maturity period than those from seed from the midde or tip-end; plants from seed from the middle have the shortest maturity period. (3) Plants from seed from the stem end of pod are generally taller than those from the middle or tip end seeds; seeds from the tip end produce the shortest plants. (4) Plants from seed from the middle of pod generally produce fewer pods

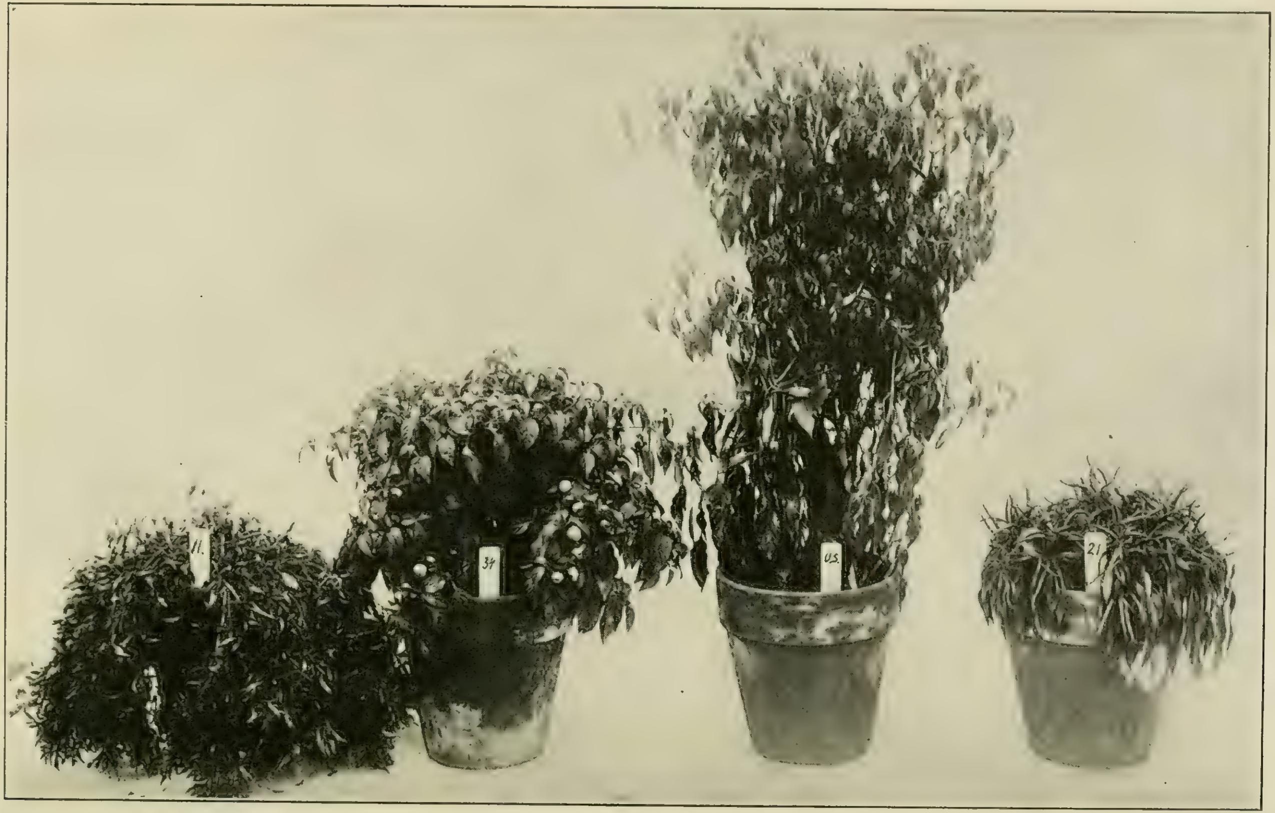

PLATE XXVIII. *Types of Pepper Plants.* Pendent, medium, standard and dwarf plants are shown in the order named passing from left to right.

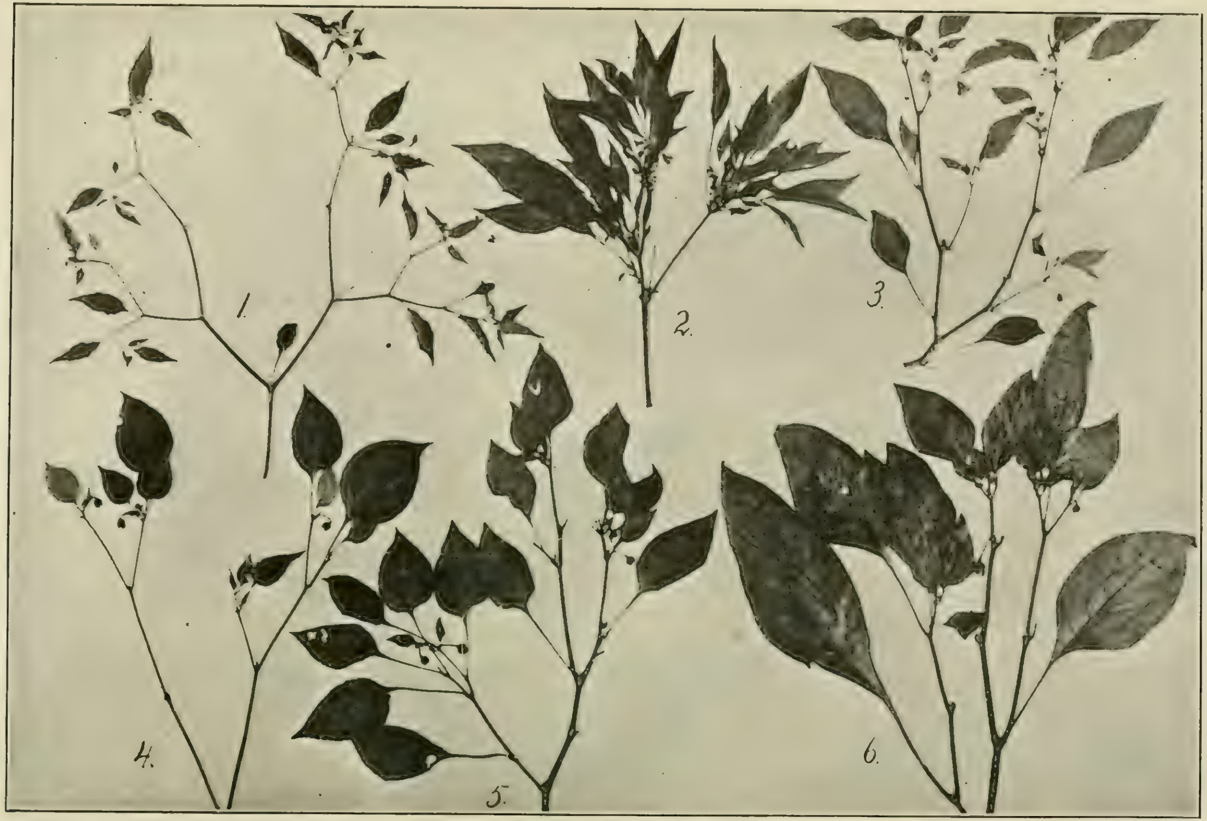

PLATE XXIX. *Types of Pepper Foliage.* Six kinds of leaves, more or less distinct, are shown from 1 to 6.

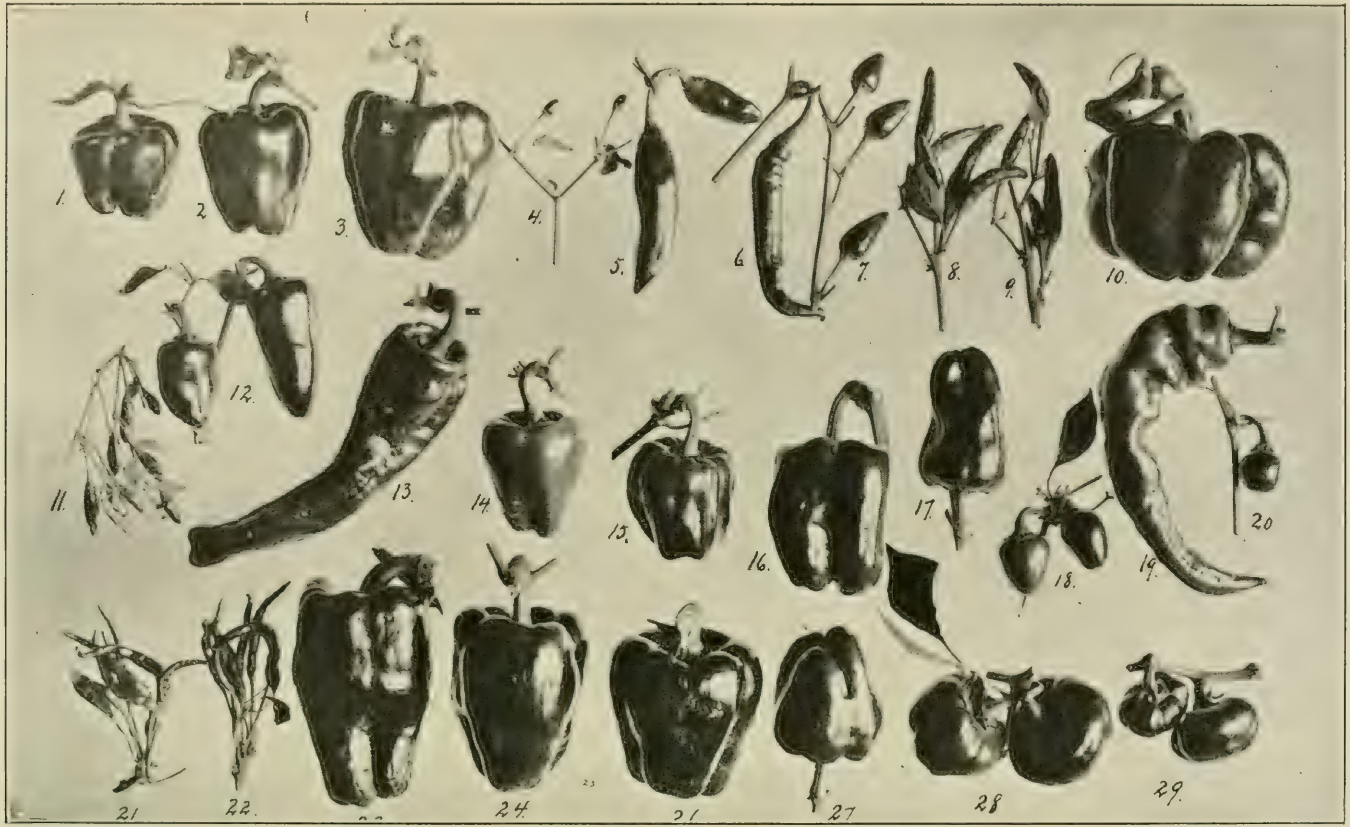
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PLATE XXX. *Fruits of Commercial Varieties of Peppers.* Showing twenty-eight sorts with their great variety of size, shape, etc.

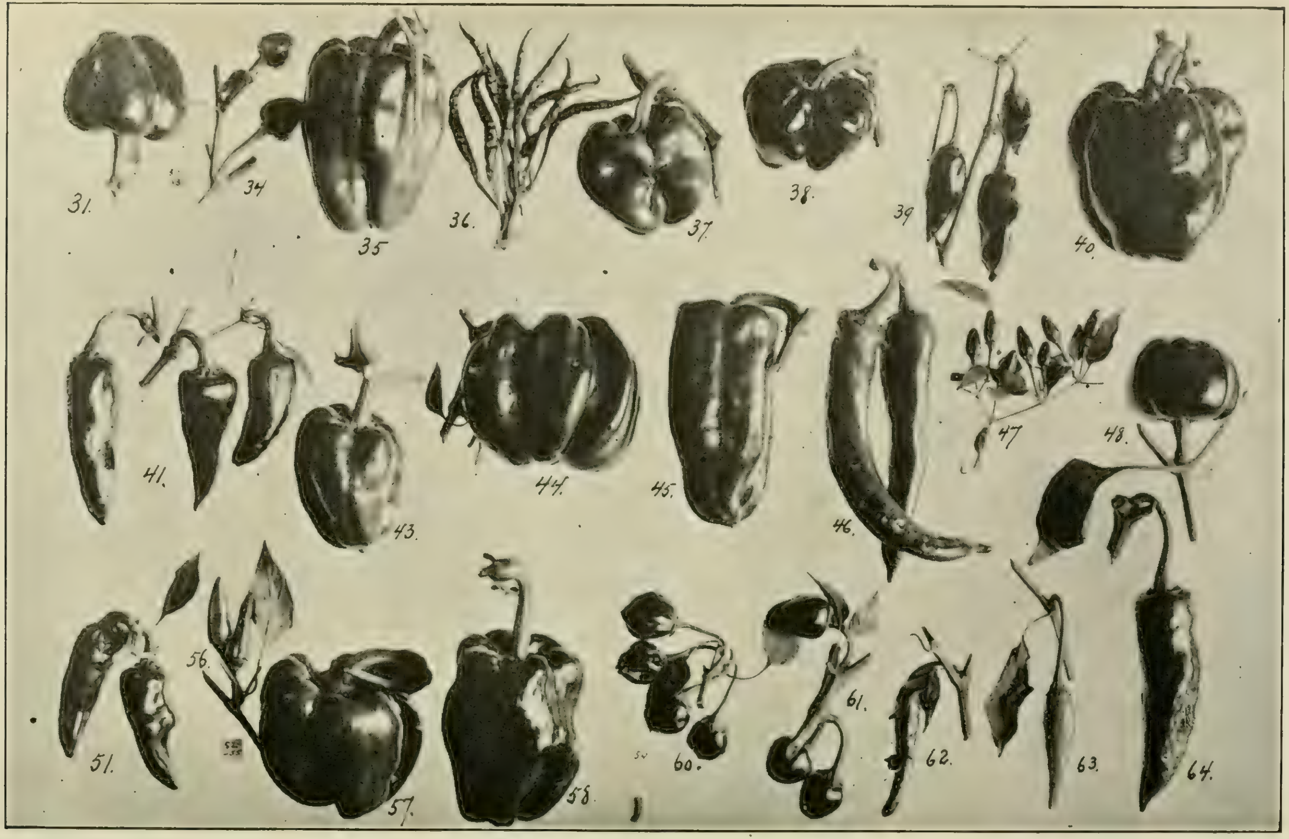
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PLATE XXXI. *Fruits of Commercial Varieties of Peppers.* This is a continuation of the varieties shown in previous plate.

than those from seeds from the stem or tip end; plants from seed from the stem end produce nearly the same number of pods as those from the tip end seeds.

Experiments with Peppers.

The work with peppers as material in plant breeding was begun in the autumn of 1907, when a large number of commercial varieties were started in the greenhouse where a study was made of varietal characteristics and many crosses secured. In May a set of the varieties was transplanted to the field, together with a similar set including the crosses grown from seed in order to compare the effect of indoor and outdoor conditions upon the plants.

Four types of the pepper plants are shown in Plate XXVIII. These plants were removed from the field and kept in pots until the foliage recovered from the wilting and brought together for the photograph. The plant (No. 11) at the extreme left is one with the stems long, slender and unable to grow upright, thus having the habit of a pendent or "weeping" plant. The next (No. 34) is styled a medium-sized plant, while the next plant (U. S. D. A. 22806) to its right, seed of which was obtained from the United States Department of Agriculture, is a true standard. No. 21 at the extreme right is a typical dwarf.

Six types of foliage are shown in Plate XXIX, the differences being very evident between the extremes given at 1 and 6. Besides the number and shape of the leaves, easily observed as the eye runs over the six samples, there are other differences that obtain as shades of green and thickness, not recorded in the picture.

Plates XXX and XXXI are of the fruits, either one or a small cluster for each commercial variety. It is seen that the number of variations in size and shape is great, and when the many colors and shades are added the assemblage is very striking to the eye.

A BIOMETRIC LIST OF FIFTY COMMERCIAL KINDS OF PEPPERS.

Station Number and Name of Variety.	Longest Diameter of Seed in Mms.	Color of Seed.	Height of Seedling One Month after Planting.	Size of Cotyledons One Month after Planting.	Size of Mature Plant in Greenhouse.	Appearance of First Flower in Greenhouse.	Type of Fruit. Consult Key.	Color of Fruit.	Taste of Fruit.	Position of Fruit on Plant.
			m. m.	m. m	c. m.	Months and days.				
1. "Early Dwarf Bell".....	3.3	Light yellow	30	35	15	6–3	11	Red. .	Mild .	Pendent
2. "Large Bell" (medium). .	3.5	Light yellow	25	33	20	6–4	11	Red. .	Mild .	Pendent
3. "Large Bell" (large).....	3.7	Yellow.....	18	30	30	6–16	11	Red. .	Mild .	Pendent
4. "Bird's Eye"...........	2.5	Dark yellow	8	17	35	9–	1	Red. .	Hot. .	Upright
5. "Black Nubian".........	3.3	Yellow.....	27	31	30	5–	3	Black.	Hot. .	Pendent
6. "Long Red Cayenne"....	3.1	Light tan. ..	22	36	35	4–	3	Red. .	Hot .	Pendent
7. "Celestial"	3.4	Dark yellow	12	30	35	7–25	7	Pale yellow	Hot. .	Upright
8. "Red Chili"	2.9	Light tan. ..	20	32	30	5–4	2	Red. .	Hot.	Upright
9. "Small Chili"...........	3.0	Light tan. ..	20	33	30	5–	2	Red. .	Hot. .	Upright
10. "Chinese Giant"	4.1	Dark yellow	20	40	25	6–17	9	Red. .	Mild .	Pendent
11. "Coral Gem"............	2.4	Dark yellow	25	32	25	4–	1	Red. .	Hot. .	Upright
12. "County Fair"..........	4.0	Light yellow	15	33	25	5–	3	Red. .	Mild .	Pendent
13. "Elephant's Trunk".....	3.7	Light tan. ..	22	40	35	5–27	5	Red. .	Mild .	Pendent
14. "Golden Dawn"	3.6	Light tan. ..	20	32	25	6–	11	Yellow	Mild.	Pendent
15. "Golden Queen".........	3.8	Yellow.....	22	34	30	6–7	11	Yellow	Mild .	Pendent
16. "Monstrous"...........	3.7	Light tan. ..	23	40	28	6–18	11	Red. .	Mild .	Pendent
17. "Neapolitan"...........	3.6	Yellow.....	23	33	28	5–25	11	Red. .	Mild	Upright
18. "Oxheart".............	3.6	Yellow.....	18	36	20	5–25	8	Red. .	Hot. .	Pendent
19. "Procopp's Giant"......	3.5	Light yellow	17	36	30	5–21	4	Red. .	Hot. .	Pendent
20. "Red Cherry"..........	3.3	Light tan. ..	15	28	35	6–1	8	Red. .	Mild .	Pendent
21. "Red Cluster".........	2.5	Dark tan. . .	17	28	25	5–25	2	Red. .	Hot. .	Upright
22. "Red Japan Cluster"....	2.3	Dark tan. . .	18	25	22	6–24	2	Red. .	Hot. .	Upright
23. "Ruby Giant"..........	3.7	Light yellow	17	25	35	6–21	10	Red. .	Mild .	Pendent
24. "Ruby King"...........	4.0	Light yellow	18	35	42	6–21	10	Red. .	Mild .	Pendent
25. "Sweet Mountain"......	3.5	Yellow.....	20	30	30	7–18	6	Red. .	Mild .	Pendent
26. "Sweet Spanish".......	3.9	Yellow.....	15	25	25	5–28	11	Red. .	Mild .	Pendent
27. "Sweet Upright".......	3.5	Yellow.....	22	38	30	6–9	11	Red. .	Mild .	Upright
28. "Early Red Squash"....	3.5	Light tan. ..	20	35	20	5–	6	Red. .	Mild .	Pendent
29. "Large Squash"........	3.5	Yellow.....	15	23	25	5–17	6	Red. .	Mild .	Pendent
31. "Upright Sweet Salad". .	2.6	Yellow.....	22	35	30	6–11	9	Red. .	Mild .	Upright
34. "Christmas"...........	3.1	Light tan. . .	14	22	28	8–13	7	Pale yellow	Hot. .	Upright
35. "Columbus"............	3.6	Light tan. ..	15	25	40	7–	11	Red. .	Mild .	Pendent
36. "Red Cranberry".......	2.5	Dark yellow	10	20	25	5–27	2	Red. .	Hot. .	Upright
37. "Giant Yellow King"....	3.5	Light tan. ..	17	30	30	5–10	9	Yellow	Mild .	Pendent
38. "Glenmont Giant"......	3.7	Dark yellow	17	28	30	5–27	9	Red. .	Mild .	Pendent
39. "Guthrey's Giant"......	3.5	Light tan. ..	15	30	40	5–15	4	Red. .	Hot. .	Pendent
40. "Italian"	3.5	Light tan. ..	15	32	25	6–15	9	Red. .	Mild .	Pendent
41. "Long Red"............	3.6	Light tan. ..	22	32	40	5–15	3	Red. .	Mild .	Pendent
42. "Long Yellow".........	3.3	Light tan. ..	14	27	40	5–6	3	Yellow	Hot. .	Pendent
43. "Mammoth Prizetaker". .	3.9	Light tan. ..	15	27	25	6–9	9	Red. .	Mild .	Pendent
44. "Ohio Crimson"........	3.8	Dark tan. . .	18	30	40	6–23	9	Red. .	Mild .	Pendent
45. "Peddrick's Extra Early Prolific"............	3.8	Yellow.....	17	28	30	7–23	10	Red. .	Mild .	Pendent
46. "New Red Hot"........	3.7	Dark yellow	25	39	25	5–	5	Red. .	Mild .	Pendent
47. "Tom Thumb".........	2.4	Yellow.....	8	16	35	7–4	1	Red. .	Hot. .	Upright
48. "New Tomato".........	3.9	Light yellow	18	33	45	5–28	6	Red. .	Mild .	Upright
51. U. S. D. A. 10,393.......	3.5	Light tan. ..	13	24	35	7–1	4	Red. .	Mild .	Pendent
56. "Yellow Chili".........	2.8	Light yellow	20	33	10	5–5	1	Yellow	Hot. .	Upright
57. "Golden Prize".........	3.7	Light yellow	16	31	25	5–21	9	Yellow	Mild .	Pendent
58. "Rex"................	3.8	Light yellow	17	33	25	6–5	10	Red. .	Mild .	Pendent
60. "Kaleidescope".........	3.8	Yellow.....	14	32	30	7–16	7	Pale yellow.	Hot. .	Pendent

CORRELATION TABLE.

Comparing Characteristics.	Division of Characteristics.	Size per Ten Seeds.	Height of Seedling One Month after Planting.	Height of Mature Plant in Greenhouse.	Appearance of First Flower in Greenhouse.	Type of Fruit. (Consult Key.)	Taste of Fruit.	Position of Fruit on Plant.
		m. m.	m. m.	c. m.	Days.			
Size per ten seeds.	23–31 m. m.	....	8–25	10–35	120–270	1, 2, –, –, –, –, 7, –, –, —, —	.....Hot.	Upright.
	33–35 "	....	12–30	20–40	150–235	–, –, 3, 4, –, 6, 7, 8, 9, —, 11	Mild, hot.	Upright, pendent.
	36–37 "	....	15–25	20–40	165–210	–, –, 3, –, 5, –, –, 8, 9, 10, 11	Mild, hot.	Upright, pendent.
	38–41 "	....	15–22	25–45	150–233	–, –, 3, –, –, 6, 7, –, 9, 10, —	Mild.	.... Pendent.
Height of seedling one month after planting......	8–14 "	24–35	....	25–40	210–270	1, 2, 3, 4, –, –, 7, –, –, —, —	Mild, hot.	Upright, pendent.
	15–16 "	33–40	....	25–40	150–270	–, –, 3, 4, –, 6, –, 8, 9, —, 11	Mild, hot.	.... Pendent.
	117–8 "	23–40	....	20–45	160–233	–, 2, –, 4, –, 6, –, 8, 9, 10, 11	Mild, hot.	Upright, pendent.
	20–22 "	30–41	....	20–40	120–228	–, 2, 3, –, 5, 6, –, –, 9, —, 11	Mild, hot.	Upright, pendent.
	23–30 "	24–37	....	10–30	120–198	1, –, 3, –, 5, –, –, –, –, —, 11	Mild, hot.	Upright, pendent.
Height of mature plant in greenhouse............	10–22 c. m.	23–36	18–30	....	150–204	1, 2, –, –, –, 6, –, 8, –, —, 11	Mild, hot.	Upright, pendent.
	25 "	24–41	10–25	....	120–197	1, 2, 3, –, 5, 6, –, –, 9, 10, 11	Mild, hot.	Upright, pendent.
	28–30 "	30–38	14–27	....	150–253	–, 2, 3, 4, –, 6, 7, –, 9, 10, 11	Mild, hot.	Upright, pendent.
	35 "	34–37	8–22	....	120–270	1, –, 3, 4, 5, –, 7, 8, –, 10, —	Mild, hot.	Upright, pendent.
	40–45 "	33–39	14–22	....	156–210	–, –, 3, 4 –, 6, –, –, 9, 10, 11	Mild, hot.	Upright, pendent.
Appearance of first flower in greenhouse............	Days. 120–165	24–40	14–27	10–45	....	1, 2, 3, 4, 5, 6, –, –, 9, —, —	Mild, hot.	Upright, pendent.
	171–180	25–39	10–30	15–45	....	–, 2, –, 4, 5, 6, –, 8, 9, —, 11	Mild, hot.	Upright, pendent.
	184–192	35–41	15–25	20–42	....	–, –, –, –, –, –, –, –, 9, 10, 11	Mild.	Upright, pendent.
	203–270	23–38	8–20	22–40	....	1, 2, –, 4, –, 6, 7, –, 9, 10, 11	Mild, hot.	Upright, pendent.
Size of fruit.......	Very small....	24–30	8–25	10–35	120–270	1, 2, –, –, –, –, –, –, –, —, —	.....Hot.	Upright.
	Small.........	31–38	12–18	20–35	175–253	–, –, –, –, –, –, 7, 8, –, —, —	Mild, hot.	Upright, pendent.
	Medium......	31–40	14–27	20–45	120–228	–, –, 3, 4, 5, 6, –, –, –, —, —	Mild, hot.	Upright, pendent.
	Large........	33–41	15–30	20–42	160–233	–, –, –, –, –, –, –, –, 9, 10, 11	Mild.....	.... Pendent.

KEY TO FORMS OF FRUITS, AS GIVEN IN BIOMETRIC LIST.

1. Slender, short
2. Slender, long
3. Not slender, long
4. Not slender, long, obscurely lobed
5. Not slender, long, lobed
6. Flat
7. Conical
8. Round
9. Swollen, lobed
10. Angular, long
11. Angular, short

OBSERVATIONS DRAWN FROM A STUDY OF FIFTY VARIETIES OF PEPPERS.

Varietal* size of seed is associated with pungency** of the flesh of the fruit or in other words, the smallest seeds produce hot fruits and the larger the seed the milder the fruit.

Size of seed increases with size of plant, that is, the smallest seed produces short plants and the larger the seed the taller the plant.

Size of seed increases with size of fruit, or in other words, the smallest seed produces small fruits, and the larger the seed the larger the fruit.

Size of seed is associated with position of fruit on the plant, that is, the smallest seed produces upright fruits, and the larger seeds produce pendent fruits.

Range in size of seedling varies inversely with that of maturity period of plant, or in other words, the taller the seedling at a given period, after planting, the sooner it reaches maturity.

BLENDS IN PEPPERS.

Of a large number of crosses secured among peppers, only twelve reached maturity during the past season; the remainder are still under study in the greenhouse. Some facts concerning the fruits of the matured blends are given below in tabular form:

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*Only varietal size, that is, the average for the variety, is considered and not the sizes, or range, within the variety.

**The familiar term "hot" is used in the tables for pungency because of its brevity, in contrast with "mild" or lack of pungency in the seeds and fruit flesh.

Record Numbers of Parents and Blends.	Form of Fruit.	Range in Width of Fruit in c. m.	Range in Length of Fruit in c. m.	Average Width in c. m.	Average Length in c. m.	Color of Fruit.	Position of Fruit on Plant.	Taste of Fruit.
1	Angular, short	5.5–8.5	5.0–8.0	6.7	6.0	Red	Pendent	Mild.
1|36	Long slender	1.0–2.0	6.5–10.5	1.6	8.4	Red	Pendent	Slightly hot
36	Long, slender	0.6–0.8	4.0–7.3	0.7	5.3	Red	Upright	Hot.
5	Long, not slender	2.0–3.0	5.0–8.5	2.5	7.5	Black	Pendent	Hot.
5|9	Long, slender	1.3–2.0	6.0–9.0	1.8	8.0	Red with black	Pendent	Hot.
9	Long, slender	0.8–1.2	3.5–6.0	0.9	4.5	Red	Upright	Hot.
5	Long, not slender	2.0–3.0	5.0–8.5	2.5	7.5	Black	Pendent	Hot.
5|11	Long, slender	1.2–2.3	3.0–7.5	2.0	6.0	Red with black	Pendent	Hot.
11	Long, slender	1.1–1.3	1.5–2.4	1.2	2.0	Red	Upright	Hot.
5	Long, not slender	2.0–3.0	5.0–8.5	2.5	7.5	Black	Pendent	Hot.
5|41	Medium, long, not slender	1.8–3.0	4.0–6.0	2.8	4.5	Red with black	Pendent	Slightly hot
41	Long, not slender	2.0–3.5	6.0–9.0	3.0	7.5	Red	Pendent	Mild.
5	Long, not slender	2.0–3.0	5.0–8.5	2.5	7.5	Black	Pendent	Hot.
5|42	Long, slender	2.0–2.8	8.0–12.0	2.6	11.0	Red with yellow	Pendent	Hot.
42	Long, slender	2.1–2.5	9.5–13.0	2.4	12.2	Yellow	Pendent	Hot.
11	Short, slender	1.1–1.3	2.2–4.3	1.2	3.0	Red	Upright	Hot.
11|56	Short, slender	1.1–1.4	2.2–4.5	1.9	3.0	Yellow	Upright	Hot.
56	Short, slender	1.0–1.2	1.5–2.4	1.1	2.0	Yellow	Upright	Hot.
17	Angular, short	2.6–4.0	3.0–5.0	3.5	4.5	Red	Upright	Mild.
17|6	Long, slender	1.8–3.0	8.5–12.5	2.2	11.0	Red	Pendent	Hot.
6	Long, slender	1.2–1.8	9.5–13.0	1.6	12.0	Red	Pendent	Hot.
26	Angular, short	5.5–7.5	5.5–7.5	6.5	6.5	Red	Pendent	Mild.
26|9	Long, slender	1.8–2.5	6.0–9.0	2.2	8.0	Red	Pendent	Hot.
9	Long, slender	0.8–1.2	3.5–6.0	0.9	4.5	Red	Upright	Hot.
26	Angular, short	5.5–7.5	5.5–7.5	6.5	6.5	Red	Pendent	Mild.
26|21	Long, slender	1.4–2.5	6.5–9.0	1.8	7.5	Red	Pendent	Hot
21	Long, slender	0.6–0.8	4.5–7.5	0.7	6.0	Red	Upright	Hot.
28	Flat	3.0–6.0	1.5–4.0	4.5	3.0	Red	Pendent	Mild.
28|51	Flat to long	2.8–5.0	3.0–4.5	3.6	3.8	Red	Pendent	Mild.
51	Long, not slender	2.0–3.0	4.5–9.0	2.5	6.2	Red	Pendent	Mild.
38	Swollen	5.0–8.0	4.0–7.0	6.5	5.3	Red	Pendent	Mild.
38|9	Long, not slender	2.0–3.0	7.0–11.0	2.5	8.5	Red	Pendent	Hot.
9	Long, slender	0.8–1.2	3.5–6.0	0.9	4.5	Red	Upright.	Hot.
48	Flat	2.5–6.0	1.5–5.0	4.0	3.3	Red	Upright	Mild.
48|36	Long, slender	1.3–2.5	5.0–8.5	1.9	7.0	Red	Upright	Hot.
36	Long, slender	0.6–0.8	4.0–7.3	0.7	5.3	Red	Upright	Hot.

SUMMARY OF THE BLENDS.

While the number of blends is not large, so far as they go, it may be stated that:

1. The long form of fruit seems to have a stronger influence than the short or flat.

2. Different sizes of fruits blend together and become intermediate in the progeny.

3. The black color of fruit is dominant over red and yellow.
4. Pendent fruit dominates the upright.
5. Pungent ("hot") taste of fruit dominates the "mild" taste.

Plate XXXII shows sample fruits of the parents with their blends between them.

GENERAL OBSERVATIONS UPON PEPPERS.

Small-fruited plants are most prolific, that is, produce the greatest number of fruits.

Small-fruited plants have the finer foliage.

Absence of light promotes the vegetative function at the expense of the reproductive function (deduced from shading experiments).

Foliage exposed to sunlight is much smaller than that grown in the dark.

Mature fruits of all colors acquire more or less red, even in the absence of light.

On the same plant, the earlier-formed fruits are often three times the size of those produced later.

All fruits are green before acquiring their normal colors.

"Hot" fruits are more apt to turn dark or pink when exposed to light than "mild" fruits.

On the same plant, the earlier the flower, the longer the period of development of fruit, the difference being as much as three weeks.

Experiments with Ornamental Plants.

Dianthus Hybrid (*Dianthus Caryophyllus-Dianthus latifolius*). This represents the crossing of a flesh-colored carnation upon a dark red pink, seed of which was sown last spring and but two plants resulted. They have a green foliage similar to that of *Dianthus latifolius*, but the leaves are more slender and drooping. One of the two has already been in bloom for two months, the double pink flowers larger than the mother and borne in clusters of two or more, being supported by stiff woody stems with large joints like the carnation. The agreeable odor resembles that of the carnation but is not so strong.

Nicotiana Hybrid (*Nicotiana "Sandrac"-N. alata* L. & O.) The "suspect" secured was grown as a blend during the past sea-

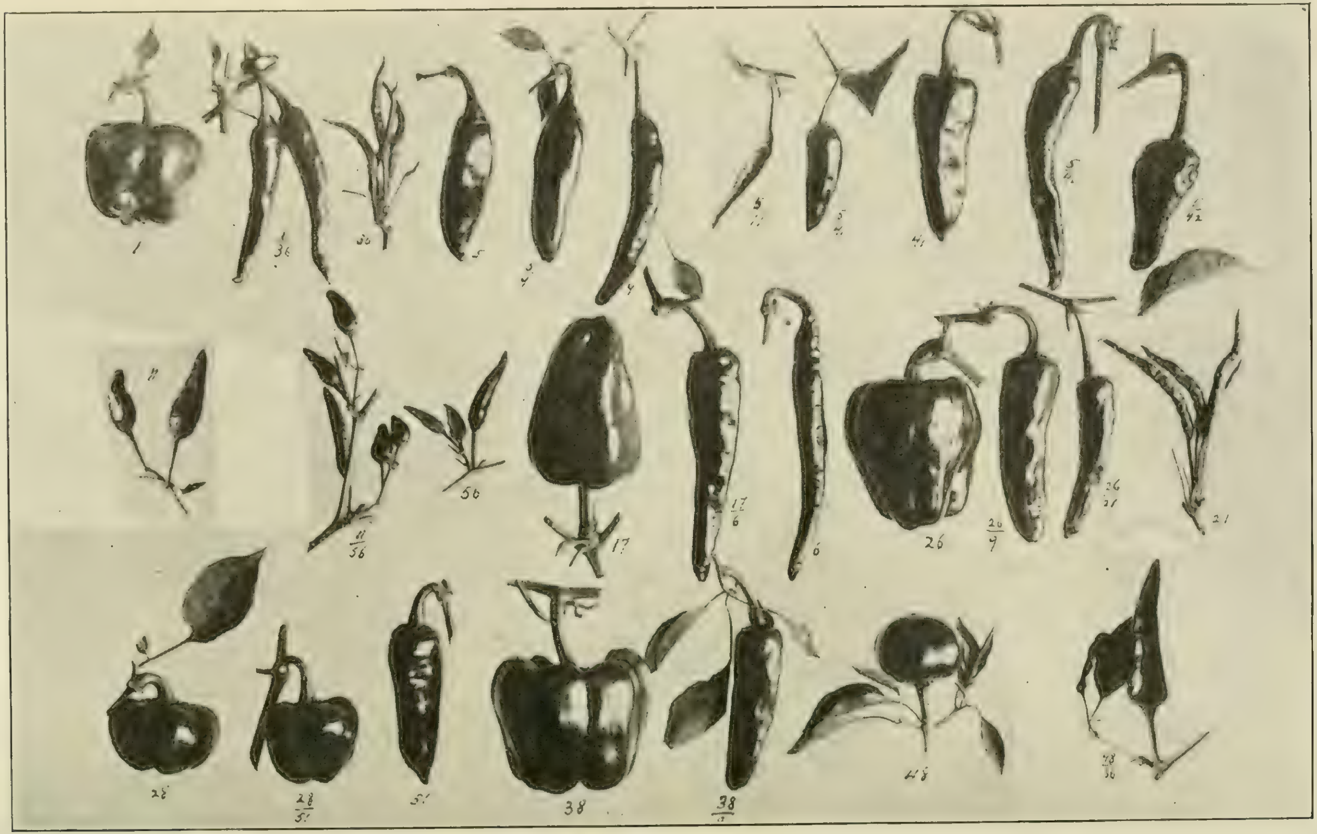
1
36
5
4
41
11
56
11/56
17
17/6
6
26
20/9
26/21
21
28
28/51
51
38
48

PLATE XXXII. *Blend Fruits of Peppers.* Several blends are shown associated with their parents.

son and gave very thrifty plants reaching a height of four feet and in general habit resembling more closely the male parent. The flowers, similar in form to *Nicotiana alata,* had a shorter tube, the petals being white above and pink beneath. The hybrid bloomed at evening, emitting a fragrance more delicate than that of *Nicotiana alata. Nicotiana "Sandrac,"* of the seed catalogues, has no odor and remains open through the day. The hybrid was not injured by killing frost, being still in bloom on November 2nd.

THE "PANSY-VIOLET" HYBRID.

A blend plant of this cross began blooming in the greenhouse during the spring of 1907, having a yellow flower which in size and form resembled the pansy. It bloomed constantly through the summer and late fall, started flowering again early in the spring of 1908 and at the time of this record (November 2nd), fully two years from the time the plant was started, is still blooming. Young plants from self-sown seed are springing up around the mother, giving first generation plants for next year's flowering.

A set of plants, representing the second generation and grown from seed of a yellow flower, is in bloom having petals edged with blue, others with petals almost entirely of that color, thus giving indication of the pansy in color as well as in size.

PETUNIA CROSSES.

"Dwarf Star-Giant Crimson." The male parent is a small-leaved bush plant with the well-known star flower, while "Giant Crimson" is a large-leaved, stocky plant with great single flowers inclined to be fringed. Plants of the first generation are dwarfish, some with fine, others with broad leaves, while the flowers vary from small to large, star-formed to deep crimson. A dark stem and leaf is associated with the dark bloom. A giant-flowered, fringed star type is in mind.

"White Fringed-Baby Blue." The blend plant of this cross was a profuse bloomer, giving a medium-sized single flower with an attractive magenta shade with a nearly white throat. The plant taken from the greenhouse continued throughout the season a mass of bloom.

"Baby Blue-Snowstorm." This cross gave a very attractive, eight-fringed flower with a delicate, shell-pink shade.

"Lavender//Single Fringed/Dwarf Star." This double combination resulted in a plant of interest because of the unusually long sepals which gave the flower an odd appearance. The light purple flower in itself was unattractive.

Breeding among the petunias offers little encouragement in the way of new varieties but the study of resulting plant types and color combinations is an interesting field.

SNAPDRAGON CROSSES.

Two varieties of the Snapdragon, "Giant Red" and "Dwarf White," were crossed for the purpose of determining the influence of color upon offspring where there is more than one color in the parent flower, also the influence of size of plant in the union. "Giant Red" is a tall plant, about three feet high, its flowers are red with a trace of yellow, while "Dwarf White" is short, about one foot high, and bears white flowers with some yellow. In all other respects, the two varieties are practically alike.

The summary of the crosses extended to the first generation is given below:

	Number of plants.	Color of flower.	Size of plant.
"Giant Red"	4	All red with trace of yellow.	All standard
"Dwarf White"	4	All white with some yellow	All dwarf
"Giant Red-Dwarf White" blend	3	All light red, intermediate amount of yellow	2 medium, 1 nearly standard
"Dwarf White-Giant Red" blend	5	All light red, more yellow than reciprocal	4 medium, 1 nearly standard, taller than reciprocal.
"Dwarf White-Giant Red" I	28	6 red, trace of yellow	4 standard, 1 medium, 1 dwarf
		11 light red, some yellow	1 standard, 9 medium, 1 dwarf.
		3 light red, more yellow than either parent	3 medium
		1 light red, white throat, some yellow	1 dwarf
		1 white, red hardly perceptible, more yellow than either parent	1 dwarf
		5 white with trace of red, some yellow	1 standard, 2 medium, 2 dwarf.
		1 white with considerable red, some yellow	1 dwarf

In the first generation, the total number of standard plants is 6, dwarfs 7, medium 15 or about one-quarter like either parent and one-half intermediate. Also, the total number of pure red like the red parent is 6, light red (including one with white throat) is 15, and where the pure white is more or less abundant, is 7, which also represent one-quarter like either parent and one-half intermediate. Thus, the figures in the first generation, together with those of the blend generation, indicate that dwarf and standard sizes in snapdragons are antagonistic una, conforming to Mendel's law, but with the red and white colors the uniformity is not clear for the red color prevails in the pure white offspring of the first generation. These crosses illustrate a quick method of securing plants of different sizes without changing the color of flower, thus a dwarf red was obtained and, similarly, a tall white (which, however, was not purely white), thus giving a standard and dwarf of both the red and white colors.

HYBRID FOXGLOVES.

Digitalis purpurea, L., a biennial cultivated species about three feet high with rugose, somewhat downy leaves, bearing bell-formed, purple flowers about two inches long, was bred upon *D. lanata* Ehrh., a perennial also differing from *D. purpurea* in the size and color of flowers, which are whitish, only one inch long, and in the texture of leaf, which is smooth having a simpler system of venation.

The general appearance of the hybrid was more like that of *D. lanata;* the flowers, however, were a half an inch longer than in this, or exactly intermediate to both parents. The color of flower is more like *D. lanata*, but the lip had a trace of purple showing the blood of the *D. purpurea*. The general appearance of the leaves is also similar to *D. lanata*, but they are larger than those of either parent, showing greater vigor and the texture of the leaves, as well as surface character, is somewhat intermediate to both parents. The hybrid developed capsules but they were without normal seeds.

NUMERICAL STUDY OF THE SEED-VESSELS OF THE "VELVET-LEAF."

The "Velvet-Leaf" or "Butter-print" (*Abutelon Abutelon* L.) is a common weed of the mallow family and a near relative of the "Cheeses" (mentioned later) and with a somewhat similar fruit—that is, the seed-vessels are arranged in a circle around a common center. It is the number of these seed-cavities that has been under consideration. First of all, counts were made of the seed-cavities of fruits from plants that grew in a fairly rich location and attained a height of four feet, with the following results, the number of instances being given under the number for each seed cavity, respectively:

	11	12	13	14	15	16
Plant 1.		4	8	2		
Plant 2.	1	3	7	3		
Plant 3.		7	33	91	66	2
Plant 4.	3	6	2	2	1	
Plant 5.		11	26	30	8	
	4	31	76	128	75	2

It is seen that the largest number of instances comes under 14. Plant 3, a giant of its kind, shows a very large percentage of its fruits with 14 or 15 seed-cavities.

A set of nine giant plants that, in a rich, cultivated field, attained a height of six feet is shown below:

	11	12	13	14	15	16
Plant 1.			13	26	22	
Plant 2.	1	3	21	23	11	
Plant 3.		5	20	44	33	
Plant 4.			3	8	8	
Plant 5.			2	21	13	
Plant 6.		1	10	22	73	4
Plant 7.		1	15	26	26	
Plant 8.			7	23	14	
Plant 9.		3	10	26	24	
	1	13	101	219	224	4

This set shows a high percentage of the 14 and 15 seed-cavities.

By combining the two sets of plants grown upon rich soil, the totals are found as follows:

11	12	13	14	15	16
5	44	177	347	299	6

Two hundred and forty-eight small plants that grew thickly upon dry, poor soil and attained a height of only twelve to eighteen inches, forming from one to three fruits each, gave the results as summarized below:

10	11	12	13	14	15	16
7	66	143	153	65	17	1

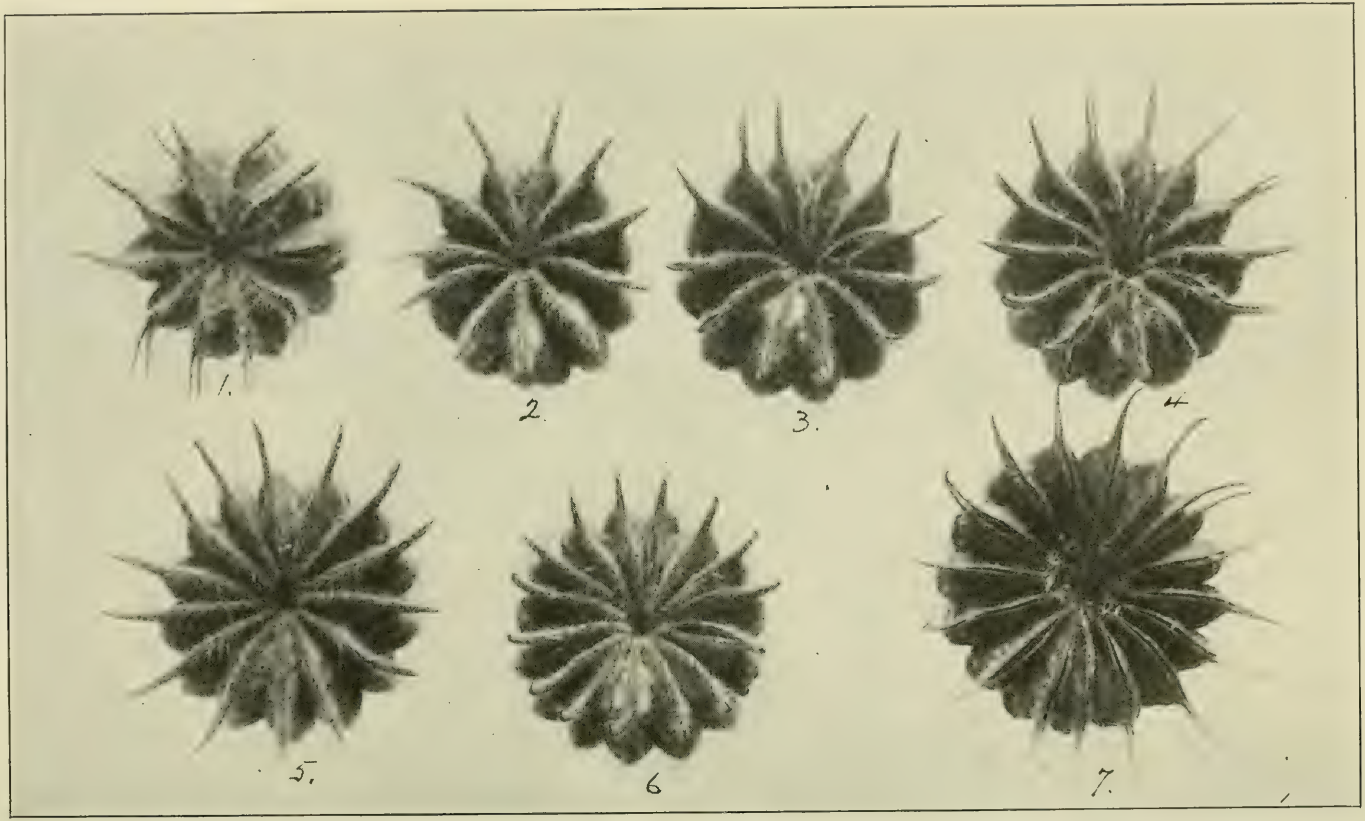

Plate XXXIII. *Velvet-Leaf Fruits.* Showing variation in number of seed-cavities from ten at 1 to sixteen at 7.

By comparing the 878 instances from rich soil with the 452 from poor ground, a total of 1,330 counts, it is seen that the average for the former is nearly midway between 14 and 15 seed-cavities, while for the poor soil plants is nearly midway between 12 and 13, or practically two seed-cavities less for the latter and suggesting that the number is much influenced by the conditions under which the plants are grown.

Plate XXXIII gives an enlarged face view of the capsules under consideration, the range of seed-cavities being from ten at 1 to sixteen at 7.

Similar results were found with the allied plant previously mentioned, namely, the "Cheeses" (*Malva rotundifolia* L.).

BARREL SHADING.

In a small way a test was made of putting barrels over three kinds of plants, namely, tomatoes, peppers and eggplants. When the upper head was left in, the covered plants did poorly and had it not been removed within a few days the plants would have perished; this was particularly true of the tomatoes, which seemed to be far more sensitive to the lack of light and air and possibly higher temperature than with the peppers and eggplants. With both heads removed, the barreled plants generally grew to much greater length than those with ordinary exposure. Only barrels of the open sort used for marketing coarse truck crops were suitable for the shading; an ordinary apple or flour barrel with both heads removed gives too much shade while the plant is small and it is probable that the lack of air circulation is not favorable for best growth.

The tomato plants, for example, grew to great length for, after reaching the top of the barrel, the stems bent down and reached the ground, thus producing plants of large size and of a striking appearance but not remarkable for an early output of fruit. It is true that the crop was much prolonged and, by covering such plants with sacking, they were kept in a thriving condition far into the late autumn.

In one case, the barrel was placed around a pepper of the truly dwarf type but without materially increasing the height of the plant. It was, however, noted that the covered plant showed a marked large development of foliage and the individual leaves were much broader—this being one of the elongated leaf-type of plants—than the others of the same kind in full exposure to the sun and air. Another pepper plant was much retarded by the shading but flowered profusely late in the season.

In Plate XIX is a representative of the barreled eggplants as photographed upon October 1st, and this is a cross of "Black Snake" upon "New York Improved," both of which parents belong to the taller sorts. The plant with its large fresh leaves is seen to be in a very healthful condition, with eleven fruits shown in view and others upon the rear side; one mature fruit had fallen to the ground. It is possible that the season favored this treatment for the two long dry periods had a depressing effect upon the surrounding fully exposed plants. The moisture in this way retained around the plant may have had something to do with the favorable result and during a wet season the outcome might have been quite different, possibly unsatisfactory.

With the plants set four feet apart each way, horse tillage of the ground was not interfered with by the barrels and hoeing close to the plants was omitted. The cost of this method of shading might prevent its becoming common in a commercial way but for the home garden, where old barrels are available without extra expense, the use of them in the way described may be worth the small effort required. It serves the added purpose of keeping the eggplant and tomato fruits from the ground where they might otherwise decay.

DISEASES OF PLANTS UPON BREEDING GROUNDS AND ELSEWHERE.

There has been less fungous disease than usual upon most of the crop plants during the season of 1908. The corn smut is always the most conspicuous of disorders and it was somewhat in evidence upon all the early sorts of sweet corn. While the smutted ears are removed as soon as they are distinguishable, it is likely that the fact that the blocks of corn have occupied the same land for several years has something to do with the presence of the smut.

For the first time, the tomato plants have been staked up, thus keeping the fruit up from the ground and in the air and sunshine. While the fruit-rot has been less, the cracking was more abundant which may be due to the sharp contrasts between dry and wet alternating periods and the greater exposure to the hot sun. In ordinary practice, the fruits are gathered as they near maturity, but here they are left on the vines for study and the decay is increased thereby. The "yellow foliage" varieties have done better than others during the past season.

Beans have been unusually free from the pod-spot and the mildew of the Limas was not met with. Some of the bacterial disease came to view upon the later sorts.

Squashes suffered from the dry, hot weather and one plot of summer sorts was saved by irrigation without any attendant outbreak of diseases. In September the downy mildew was abundant and suggested the possible necessity of spraying for its prevention in coming years.

Peas do well as an early crop and seem to get ahead of their troubles, which appear in full force when any attempt is made to grow a late or second crop. Mildew and pod-spot are the leading enemies but these seem only an incident and the hot dry weather the chief reasons for failure.

Eggplants have been unusually free from the leaf blight, but as the fruits are not removed when market-mature, they decay considerably before they are seeded.

Peppers are a new field crop and the foliage of all the varieties has been particularly clean. Occasionally a plant has wilted in the most trying hot weather and afterward died. Only a few of the ripe fruits have shown the anthracnose.

Udo has been the most conspicuous of the blighted plants upon all the grounds. Last season saw but a few plants left of the many in the block and now these are practically worthless. This Japanese salad plant, while of high table quality, seems unsuited to the conditions that obtain here.

Rainfall of the Growing Season for Past Twenty Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	Average.
April	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.43	2.88	3.64	3.78	2.72	3.45
May	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	1.71	4.21	5.05	7.10	4.12
June	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.43	4.48	4.41	2.32	3.63
July	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	4.06	5.58	2.62	4.70	5.21
August	5.18	4.90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	5.72	5.95	3.45	5.05	5.04
September	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	5.23	2.19	8.08	2.09	4.04
Totals	36.87	25.75	21.16	20.85	24.77	24.79	18.13	24.28	31.28	24.16	20.46	27.11	26.64	29.61	28.04	25.44	23.03	26.05	27.39	23.98	25.49
Average	6.14	4.29	3.53	3.47	4.13	4.13	3.02	4.05	5.21	4.03	3.41	4.52	4.44	4.93	4.67	4.24	3.84	4.34	4.56	4.00	4.25
Rank in Wetness	1	9	17	18	12	11	20	13	2	14	19	6	7	3	4	10	16	8	5	15	
Rank in Dryness	20	12	4	3	9	10	1	8	19	7	2	15	14	18	17	11	5	13	16	6	

Temperature of the Growing Season for Past Twenty Years

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	Average.
April	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	46.7	49.9	51.2	45.2	51.2	49.8
May	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	62.8	61.4	61.0	55.4	61.6	60.7
June	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	68.3	70.4	64.7	69.9	69.3
July	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	72.3	74.4	72.8	73.6	75.6	73.9
August	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	71.1	74.6	70.5	70.6	72.2
September	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	64.8	65.4	68.9	67.1	65.7	66.2
Average	65.2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64.3	64.0	64.3	65.1	66.5	62.7	65.8	65.3
Rank in Warmth	12	14	11	10	15	4	5	2	16	6	7	1	8	17	19	18	13	3	20	9	
Rank in Coldness	9	7	10	11	6	17	16	19	5	15	14	20	13	4	2	3	8	18	1	12	

Sunshine of the Growing Season for the Past Twenty Years in Percentage of Clear-Partly-Cloudy Days.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	Average.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
April	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	77	83	67	77	69.1
May	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	74	77	68	61	71.0
June	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	77	73	73	93	77.0
July	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	81	81	64	81	76.0
August	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	74	68	84	65	77.0
September	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76	80	60	63	75.0
Average	61.5	73.5	72.2	74.8	73.3	74.7	78.2	75.2	80.0	72.5	79.3	80.5	69.5	76.3	72.5	7.77	76.5	77.0	69.3	73.3	74.2
Rank in Brightness	20	12	17	10	13	11	4	9	2	15	3	1	18	8	16	5	7	6	19	14	.
Rank in Darkness	1	9	4	11	8	10	17	12	19	6	18	20	3	13	5	16	14	15	2	7	

WEATHER NOTES OF THE GROWING SEASON.

Upon page 298 is given a table of the rainfall for the past twenty years for the whole State during the six months, including April to September. It is seen that for the current year the precipitation for the growing season has been below the average by a total of 1.51 inch. It is noted that May was a very wet month followed by a dry June and July with August normal and quite dry again in September. It was not the actual lack of rain so much as its unequal distribution that made the season so unfavorable for many truck crops. There have been five years in the last twenty with less precipitation than during the warmer half of 1908.

Upon page 299 is given in tabular form the temperature of New Jersey for the growing season and it is to be seen that the first four months were above the average for the past twenty years. There have been, however, eight other seasons that exceeded 1908 in warmth.

A corresponding table for the sunshine is given upon page 300 and here it is shown that the past season has been only a little above the average in brightness.

As a whole, the season with which crop growers have been dealing in 1908, was dry, warm and bright, and as a consequence, many suffered from these factors of the prevailing weather.

REPORT

OF THE

BOTANICAL DEPARTMENT

OF THE

New Jersey
Agricultural College Experiment Station

New Brunswick, N. J.

BY

BYRON D. HALSTED, Sc.D.

For the Year 1909

TRENTON, N. J.
STATE GAZETTE PUBLISHING CO., PRINTERS.
1910.

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REPORT OF THE BOTANIST.

REPORT OF THE BOTANICAL DEPARTMENT.

BYRON D. HALSTED, SC.D., B. H. A. GROTH, PH.D.,*
EARLE J. OWEN, M.S., NAHUM D. SHORE, M.S.†

It is the endeavor to establish the Botanical Department upon a basis that will be in accord with the spirit of the Adams act, and to this end some of the old lines of experimentation are being merged in new ones and other lines begun. The area of the gardens has been much curtailed that a more intensive study of the growing plants may be prosecuted, and the desire of originating new sorts of vegetable fruits is being replaced by a study of breeding, out of which the novelties will come as a by-product of the investigations.

The leading kinds of plants that have shared in the work of the Department for the year are: beans, corn (sweet), eggplants, peas, peppers, squashes and tomatoes. A study of the crosses and hybrids among each of these seven foremost vegetable fruits has been continued, and some of the results of the year are given in the following pages. As this work continues it will lose more and more its popular nature, and the results will naturally take the shape of special or technical bulletins, while the annual reports, becoming less bulky may assume the form of a statement of the year's progress, and in terms to serve the general reader.

In recognition of the prime essential to substantial research work of the study of the activities of plants, a plant physiologist, in the person of Dr. B. H. A. Groth, has been added to the staff, who, with a laboratory provided in the short course building, and within easy access to the gardens is taking up some of the problems much in need of solution. It is too soon for a report of finished work, but a study has been begun upon a number of crops and the tomato in particular. For example, notes were made as to size of plant (at different ages), shape of leaves, type of inflorescence, various details of the fruit, &c., and a large amount of material was preserved for close study. Several lines of physiological experimentation were prosecuted in the greenhouse during the summer, upon one of which Dr. Groth makes a preliminary record in this report.

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*Began April 1st. †Died September 20th.

The work with beans has been largely with the dwarf snap and lima sorts, following up lines that were projected some years ago; especial attention being paid to a series of crosses between mottled and white limas, some additional results of which are given in this report. The study of the hybrids between snap beans and the scarlet runner has been continued and a large number of attempts to hybridize the snap and lima species are under way. An effort has been made to list the una of the beans and determine whether they are antagonistic or sympathetic in each case.

With the sweet corn there have been a study of (1) the crosses between standard sorts and typical western field varieties; (2) the behavior of crosses when color of the grain is different, as the "red," "ruby" and "Calico" sorts; (3) the flintiness in the grain, and (4) the effect upon size, vigor, &c., of the crossing of a very small dwarf ("Yellow Pop") upon a standard white field sort. Under the first heading the work has involved the distribution of many packets to testers throughout the State, and elsewhere, a condensed partial report of which is given, showing that the added vigor of the field parent was the probable factor that saved these crosses from the destruction that came to the early ordinary sweet sorts, incident upon the prolonged drought of early summer; as a matter of fact, the crop of "sweet-field" corns was good and the quality of the grains excellent.

In the case of the eggplant, the studies have been chiefly along two lines, namely (1) "American" sorts and the ways they act upon each other other when bred together, and (2) the development of an edible sort out of the hybrid, between the "American" and the "Chinese" species. The general details of the latter, in particular, are given in this report, while the several steps taken and the results in full may become the subject for a special bulletin.

The peas, peppers and squashes represented a suitable set of vegetable fruit plants for a seasonable distribution of labor, and two years ago were placed in the immediate charge of Mr. Shore. Unfortunately, during midsummer of the present season he was taken suddenly and seriously ill, and, therefore, the work of breeding, &c., has been largely omitted and as a consequence the report for these important crops will be fragmentary and brief for this year. A very noticeable result of fertilization within the plant among the squashes was a feebleness of the vine followed by a failure of the crop.

A large part of the home grounds was devoted to the study of the tomato. Having a fairly full set of the parents and some thousands of plants, representing hundreds of crosses, the opportunity has been ample for a consideration of the una that make up the tomato plant, and their reactions upon one another when subjected to the various combinations possible in crossing and recrossing the varieties. It is in mind to develop a classification of the cultivated sorts of the tomato, founded upon the stable una and show the range of variation that may be possible under each sort.

While seeking for rules of breeding that may be of general application the long fruit of commercial size is still kept in view, and, as a matter of fact, a large number of the plants bore fruit of much promise in this regard. It will be of interest to show that the "Goose-egg" fruit of marketable size has been obtained along more than one line. While the breeding of the slender "plum" or "pear" type, with a large apple-shape is quite fundamental, in this work it has been found that when several widely different types are blended by crossing and recrossing some striking forms come to the light that are, of course, propagated by cuttings, and possibly by breeding these within the plant, desirable results may be reached without great loss of vigor.

Some work has been done upon the internal structure of the tomato (pepper and eggplant also). While the number of seed cavities (locules) does not express the full meaning of the interior of a tomato; by counting of them in equatorial sectional view and in large numbers, a knowledge of the constancy or variability of this characteristic is obtained that may help in securing the ideal interior. It has been shown that with some kinds the number is fairly constant, particularly when it is two or three, as in the smaller ("currant," "cherry," "plum" and "pear") sorts; in the large, flat and irregular kinds ("Ponderosa") the locules are numerous, very variable and a single section does not reveal them all.

When the smaller and the larger fruited sorts are bred together a great variety in number results; some plants seem to adhere to a number differing from that of others of the same origin.

A number of okra crosses have been grown, and the same plot included a hybrid of the "Golden Bowl" upon the okra, remarkable for its extreme vigor.

The ornamental border contained several hybrids of promise and in particular these of the carnation-pinks.

During the year, one bulletin, namely, No. 218, "Vegetable Fruits-Seed Distribution for 1909," has been issued. The usual amount of time has been given to the details of the office desk and laboratory, consisting of correspondence concerning the habits of plants, and the inspection of seeds, diagnosis of diseases, &c.

THE EXPERIMENT AREA.

The ground devoted to the gardens for 1909 consisted of (1) the two acres of home grounds, as described in previous reports; (2) an acre in three strips alternating with forage crops of the farm department, and (3) a block of nearly two acres acquired this season, and called the "North Lot"—taken in exchange for the four-acre tract known for the past two years as the "Smock Land."

To this should be added the land, scattered in small patches throughout the State, that was used by the many persons who received seeds, and kindly volunteered to act as testers for the Experiment Station.

Experiments with Corn.

"IOWA SILVER-MINE STOWELL'S EVERGREEN" CROSS (144–93).

In 1906 the "Iowa Silver-Mine" was bred upon the "Stowell Evergreen," and the starchy, dent grains thus secured upon the "Stowell" ears were planted in a block in 1907. This yielded a crop of ears (Plate IV., 1907) one-fourth of which were sweet. These grains became the basis for a block in 1908, which produced a fine lot of solid sweet ears. A distribution was made of this crop and also from specially selected ears a block of forty-eight hills was grown upon the home grounds. The upper row of Plate I.* is occupied with ears from this crop, the four upon the right being photographed as taken from the field when the husks were dry, but the grains still plump; those upon the left were gathered earlier and had become cured.

The plants were large with but very few suckers, the ears borne high, occasionally two upon a stalk and of very acceptable form, but perhaps too large for table use in some hotels. The fourteen to eighteen rows of deep grains were usually straight, and the color was so fine a white that the name "Silver Sweet" is fully merited.

Aside from the points of excellence named above, it possesses the one that was primarily sought for, namely, vigor of plant, for which during such a season as the last it means all the difference between a crop and a failure. Sweet corn as a rule throughout the State was nearly destroyed by the long dry weather of the mid-growing season.

The following are the reports of the few practical growers who had this cross for trial.

REPORTS FROM TESTERS OF "IOWA SILVER-MINE STOWELL EVERGREEN."

(1) "Planted April 23d—first picking August 10th. Ears medium and uniform in size—a good boiling and roasting corn." (2) "The corn was fine—large ears and the flavor was excellent; grains large and sweet." (3) "High stalks, some over eight feet—large ears, sixteen rows of medium sized kernels. Fairly sweet. Average one and one-half ears to stalk." (4) "Average height, seven feet, fairly vigorous considering dry season. Three-fourths planted had two ears six to eight inches long—mostly like Evergreen, but a good many irregular. Quality very good." (5) "Plants were very vigorous and productive—from seven to eight feet high, despite a most severe drought, when they were completely destroyed by cattle a few days before the ears would have been sampled on the table. If this corn is of good table quality it is an acquisition." (6) "Partly a failure; too dry until late,

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*Plates I.–XXV. in this report were made from photographs by Mr. F. H. Dodge, to whom many thanks are due for his courtesies and painstaking skill.

but matured a few good ears of larger size than Stowell's in another plot—would have been lots of ears—ran eighteen to twenty rows to cob and flavor was excellent." (7) "The plants which came up seemed to be about the same as the regular Stowell Evergreen."

"IOWA SILVER-MINE COUNTRY GENTLEMEN" CROSS (144–19).

The above cross was begun at the same time (1906) as that last mentioned and the details of the work are parallel with it. Sample ears of the block grown upon the home grounds are shown in the lower row in Plate I. The plants while strong were not as tall as those of the "Stowell" cross, previously described, but stood the dry weather and made a good crop of midseason ears. It is seen by the specimens that the ears are much more slender than the "Stowell" cross and often are filled out of the tip like the most desirable type of field corn. The grains are long and in the whole block were practically all of the zigzag arrangement. In quality this cross seems to be fully equal to the high standard of its mother and the larger size of ear cannot but meet with favor. To distinguish it from any other of the "Shoepeg" sorts it will bear the name "Jersey Sweet."

The reports of the growers who had this cross for a practical trial are given below.

REPORTS FROM TESTERS OF "IOWA SILVER-MINE COUNTRY GENTLEMEN."

(1) "The above-named sweet corn takes the lead for me in yield and flavor of all other kinds I have tried. The ears are large and fine." (2) "Length of stalk, four to seven and one-half feet; dry weather very bad. I believe in good weather it would average seven feet. Did not bear half crop on account of drought; ears seven to eight and one-half inches long; quite a good many yellow grains, about 10 per cent. zigzag. Quality good." (3) "Very fine large strong stalks, two ears on most of the stalks; fine quality." (4) "Strong grower; fine quality of grains." (5) "Stalks of this corn about eight feet high, ears good size, one ear twenty rows, seven inches long; forty-seven grains in row; very

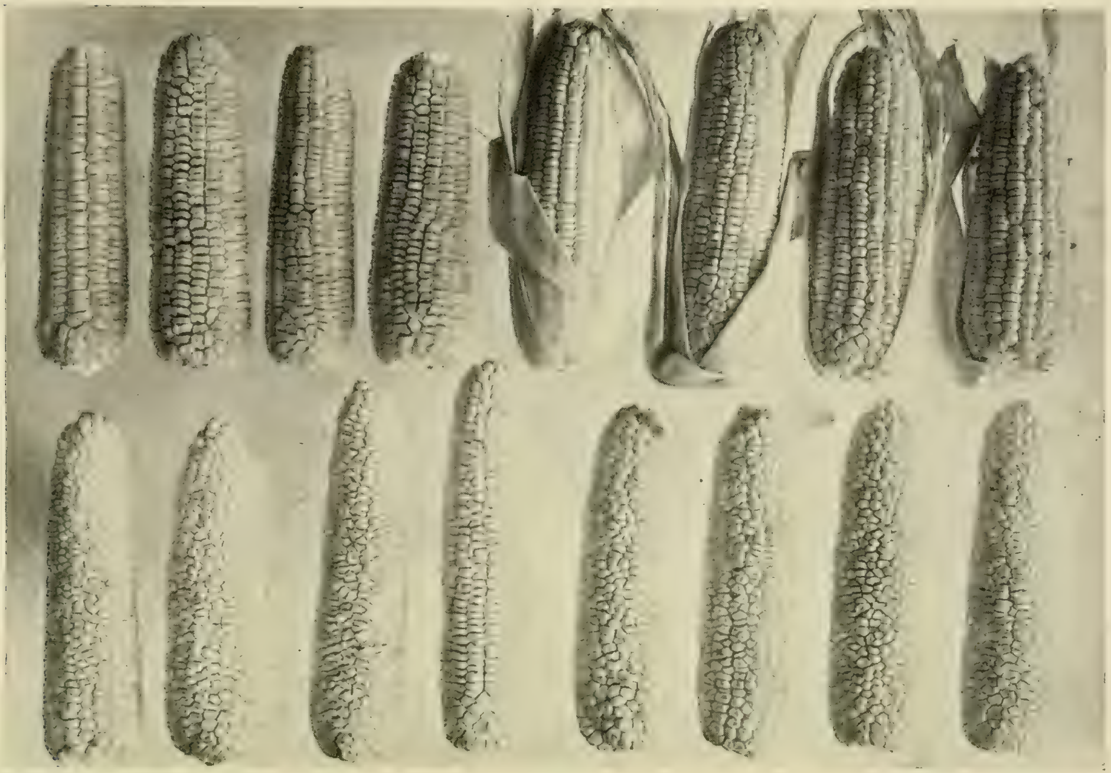

PLATE I.

Crossed Corn—The upper half shows a row of ears of the "Iowa Silver Mine-Stowell Evergreen" cross, the left four ears being somewhat dried. The lower half shows the "Iowa Silver-Mine Country Gentlemen" cross, picked when the husks were dry.

good flavor." (6) "Corn planted May 5th, cut it to eat August 8th; some of the ears were nine inches long, having fourteen to eighteen rows, and grew eight to nine feet tall—as to eating quality do not see how it could be improved."

THE "PRIDE OF NISHUA-STOWELL'S EVERGREEN" CROSS (145–93).

The above cross is of the same age as the two previously mentioned—the "Pride," being a yellow dent instead of the white of the "Silver-Mine," and having a "rusty" cob, gives two strains as to cob color and two for grain, whether yellow or white. Only white sweet grains were planted as there was lack of space and there is a prejudice against the yellow color.

One block was planted with grains from "rusty" cobs and from the three ears only that had been borne by a single stalk. The general appearance of the ears is shown in the upper row of Plate II. Near the middle is a pair of ears united by their husks, produced upon the same stalk, with the shape the same as the other ears, but much smaller. The ears just to the left of this was unusually large, and is much more dried than the others. In quality the grains are superior and the plants in this block were large, strong and in every way desirable, excepting in the matter of ear production; there was too great a tendency for twins and triplets, and as a result there were many small ears that were not well filled out. The results might have been more satisfactory had the season favored the crop. So far as this test goes it is not favorable to the selection of a triplet for the mother. The forty-eight hills yielded 130 ears, many of which were like those shown in the picture besides a score and more picked for testing at various times as they were table mature.

The ears, as to the color of cob, were as follows: White throughout, forty-eight; cobs variably "rusty," seventy-nine; cobs and grains both involving the "rusty" color, three.

A block of forty-eight hills, as above, was planted with white grains from white cob ears and yielded a quite uniform lot of plants—eight ears of which are shown in the lower half of Plate II.—the four to the right being freshly picked and the others somewhat dried. As a rule the ears, often twins, are more slender than the first mentioned block. The tips were often with good grains covering them as in high-grade field sorts. Of the 116 ears sixty-one were white throughout, thirty-three with "rusty" cobs and twenty-two showed the color in both cob and grains. The color of the cob is not like a grain quality and cannot be removed by simply selecting ears free from it.

REPORTS OF TESTERS OF "PRIDE-STOWELL'S" CROSS.

(1) "Corn grew strong and quickly, each stalk bearing two ears twelve inches long; very tender and sweet." (2) "The corn grew to the height of eight feet, the length of the ears were nine and ten inches; the ears were very full and very sweet; sandy soil." (3) "Large stalks, large full ears; fine eating corn. This corn did better than any other sweet corn I planted this year." (4) "Corn matured a little later than some of my other varieties. Cobs and grains much larger than any other I had; large grains; flavor good. Stalks larger than usual (one was twelve and one-half feet high), perhaps due to extremely dry season; no more than one ear to stalk. Noticed only a slight red tinge to cobs; altogether a very satisfactory corn."

CROSS OF FIELD DENT UPON DWARF POP CORN.

A pot-grown plant of a white field dent corn was crossed upon a dwarf yellow pop in the greenhouse last winter, and from seed thus secured four hills were grown during the present season. The ear from which the field dent potted plant was grown is shown at the left in Plate III., and to the right of the row are five of the ears of the pop corn while an equal number of the crossed ears are between the two parents.

The field corn is one of the sorts largely grown for its desirable ears of large white dent grains, and the mother is a variety of very dwarf habit, not exceeding thirty inches in height, and bearing the short and in every way small ears a foot or less from the ground. The contrast is in nearly every quality.

The cross plants, of which twenty were grown, were quite variable in size, and in time of maturing the ears—but the average was midway between the two parents grown near by for comparison.

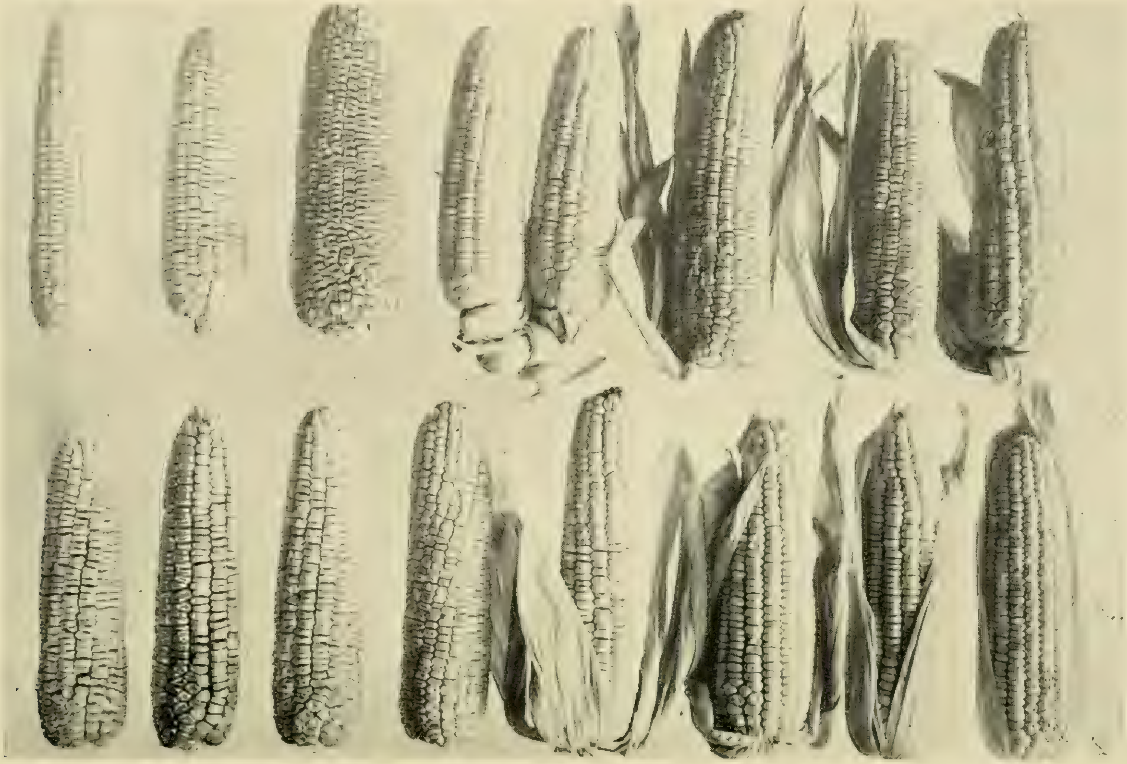

PLATE II.

Crossed Corn—"Pride of Nishua-Stowell Evergreen" crosses, the upper from a parent bearing three ears, the lower from selected grains, and the right hand four ears fresh from the plants.

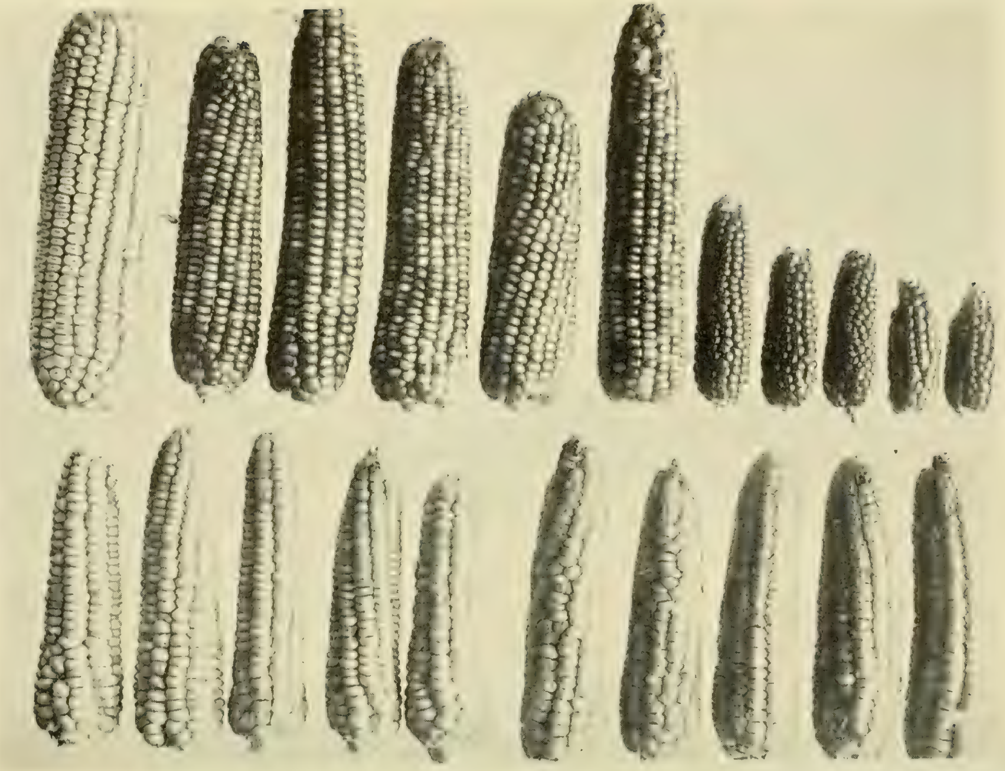

PLATE III.

Crossed Corn—The upper row shows, at the left, an ear of white dent field corn and to the right five ears of dwarf yellow pop with five ears from blend plants of the cross. The lower half shows "Malamo" sweet corn, the left five ears being from flinty mother grains and the right from the same lot, selected for sweet grains.

The ears of the cross seem to approach quite closely the size of the white parent, but, as a matter of fact, the two longest and heaviest weigh in the same notch with the large white ear, and the next to the largest of the pop ears. In weight of whole ears, therefore, an average is struck, and in the weight of the grains only, the ratios are: White, 4; cross, 8; pop, 17; that is, the weight of the crossed grain is nearer the large than the small-grained parent. In length of grain the ratios are 5, 7, 11, and in breadth, 9, 8, 11. In other words, the pop grains are as wide as they are long, and the cross somewhat longer than broad, and the field grains are very much longer than broad—all of which shows a blending of the dimensions in the cross.

The grains of the middle one of the set of cross ears were shelled and counted, with the following results: White, 170; orange, 191; lemon yellow, 302. The two yellows are not separated with ease, and therefore this may account for the variation from the theoretical—assuming that the orange-colored ones are the pure dominants and the lemon (pale) yellow the "hybrids." The two shades of the cross are very evident in all the ears of the cross, and the inference is that the white dilutes the yellow in the "hybrid" grains.

FLINTINESS AS INFLUENCED BY ENVIRONMENT.

Grains from a practically solid flinty ear of "Malamo," grown upon poor soil in 1908, were planted in a block of thirty-two hills in the home grounds where the soil approaches a garden condition, and much better than that upon which the seed was grown the previous year.

The season was unusually poor for early corn, but the plants made a fair growth; much better than those from "sweet" "Malamo" seed planted in a distant part of the same area as a check. Of the sixty-six ears of fair size harvested, thirty-four were flinty and thirty-two generally sweet. The lower part of Plate III. is occupied with five of the most flinty ears at the left and these showing the largest amount of sweet (wrinkled) grains at the right. The reader is to bear in mind that all gradations between those two sets make up the remaining fifty-six ears. In a general way it seems fair to state that there are about an equal number of the flinty and the sweet grains in the whole lot of ears, and this shows that the flintiness of the seed planted is not reproduced in full in the crop under the conditions named.

A study of the whole set of ears leads one to feel that in some instances the flintiness or its absence seems to indicate a plant character, for in some ears the sweet grains are the rare exception and in others the flinty ones are scarce. Sometimes an ear will have all its grains in a semi-flinty condition, as shown in the middle ear of the "sweet" set. Again one may be led to the opinion that the grain in its starch unum acts quite independently of its neighbors, for among a large number of smooth ones will be a strongly wrinkled one, as shown in the flinty ears of the plate.

In connection with this directing force of the ear as a whole, or better, the whole plant (for when there are twin ears both are practically alike in shaping power upon the grains), and the self-centered energy of the kernel itself there is the possibility of xenia being active among these grains that otherwise would be much more uniform. It is probable that the drifting of the original sweet corn has gone far enough toward a true flint corn, so that starch forming quality becomes a Mendelian factor when bred with those grains that are more sweet than flinty; in short, the flinty grains in an otherwise sweetish ear may be due to fertilization, by pollen bearing the starch forming power.

"BLACK MEXICAN" WITH "STOWELL'S EVERGREEN."

For the purpose of aiding home breeding of truck crops a quantity of "Black Mexican" and "Stowell's Evergreen" sweet corn was distributed to those who requested it, along with directions for the proposed trials. The stock of seed was obtained with special request for purity, from one of the leading seed houses, with a high reputation acquired through a century or more of square dealing. That the Department might keep closely acquainted with the work as it progressed, an isolated block was grown upon the Experiment Station grounds in parallel rows of the two sorts, &c., as outlined in the bulletin.*

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*Bull. 218—Vegetable—Fruit Seed Distribution for 1909.

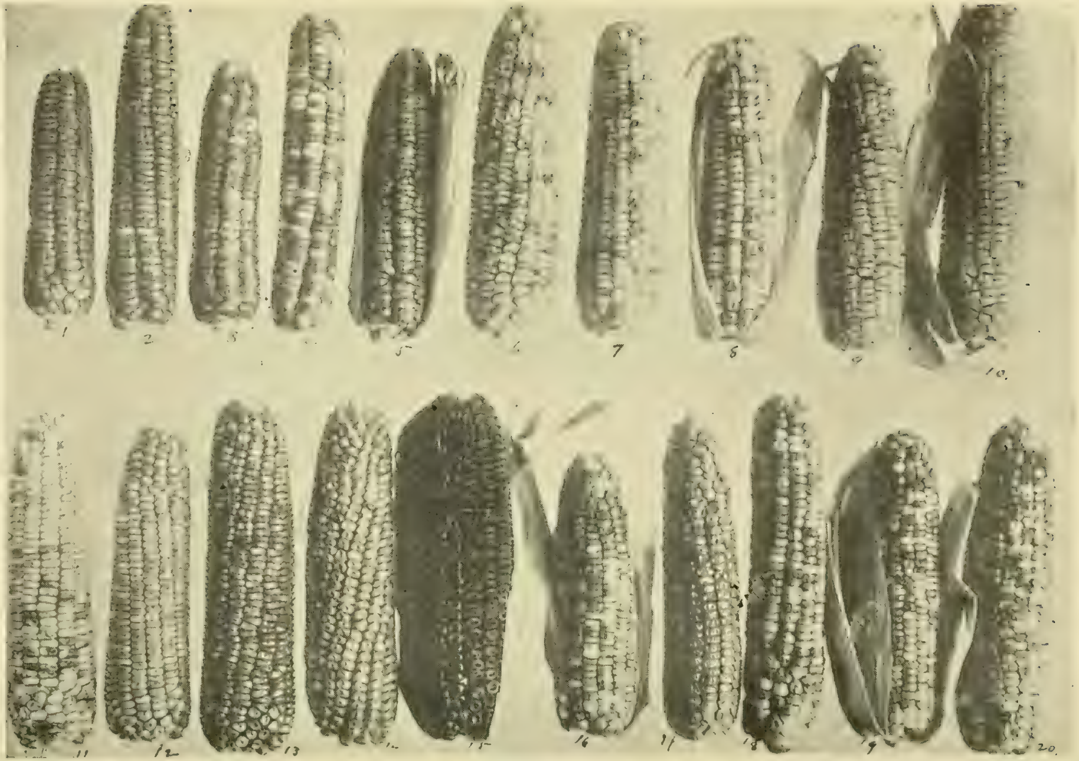
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PLATE IV.

Crossed Corn—The upper row shows five ears from "Black Mexican" hills grown with "Stowell," and to the right five ears of the "Stowell" grown with the "Black Mexican." The lower row to the left shows five ears from "Calico" corn, and the five ears to the right are of the cross of "Voorhees Red" upon "Egyptian."

The upper row of ears in Plate IV. show some of the results of this first step in the breeding of two commercial varieties of corn together. Upon the left are five sample ears of the "Black Mexican," the two end ones entirely black (slate), while the other three show white grains, one of them in large numbers. Ear 2 has ten grains more or less white, none absolutely; ear 3 has five white and sixteen whitish grains, while ear 4 bears thirty-eight white and forty-two showing a pale color of the same shade as many of those upon the "Stowell" ears to the right. This ear has 344 grains, described as follows: Black, 271; pale slate, 42; white, 38; it seems that the mother grain was a cross between a "Mexican" and some white sort, and growing alone or with its own cross might yield under the Mendelian rule, 86 pure black (slate), 172 cross, and 86 white. As a matter of fact the pollen exposure for any one ovule was nearly equal between the white and black sorts, so that regarding the dominance of the black on the white as three to one in favor of the black, the white grains would be greatly reduced.

It seems probable that the solid black ears, as shown at 1 have utilized white pollen in many instances without any signs of it appearing in the grains thus produced. The greater trouble comes with the ears that show only an occasional grain, one to ten or less when the half black mother assumption does not hold. If the progeny from such white grains show the "Stowell" influence, it will be necessary to attribute it to a crossing taking place of the white upon the black with no dominance for the black.

The "Stowell's Evergreen" showed all degrees of the mixing; no ear was entirely without dark grains, while some had fully a third or more marked. Some ears had the crossed grains generally much darker than others, suggesting that the taking of the color is somewhat of a plant quality. This variation among the ears as a whole has often been noticed in years past, and is not to be dismissed as a question of age of the grains. When a plant bears two or more ears and consequently of different ages of ripening, one of the striking things is the great uniformity in the matter of displaying the same shade of color. The same is true whether the color in question be black and white or yellow and white.

In addition to the variation, among the ears, of the intensity of the color, there is a wide range upon the same ear. Even with those ears where the color generally is strong there will be grains with only a cloudiness showing through the colorless skin, and frequently so indistinct that the person who attempts to separate the colored from the uncolored will feel that there is a possibility of some of the crossed grains showing no signs of the fact so far as the color goes. This assumption seems to account for some of the results that are met with in the breeding of different colored corns.

"CALICO" CORN AND PROPOSED CROSSINGS.

In the lower left-hand corner of Plate IV. are shown five ears of the "Calico" field corn, which was grown the past season as a breeder row upon two sweet sorts, namely, the sweet strain of "Iowa Silver-Mine" upon "Country Gentlemen" and the "Stowell's Evergreen" standing in parallel rows upon either side of the "Calico." This latter sort is a good sized dent corn, with the grains most variably marked; the ears as such vary from those that are almost free from color in the skin of the grains (11) to those that are solid red (15), while others have each grain marked quite similarly with fine chocolate lines. Among the fifty and more ears secured there were no two alike in the markings excepting when they were borne by the same stalk, and then they closely resemble each other, even to the minute details of the markings; this kind of coloration is not a grain peculiarity, but of the whole ear, and all the ears, or in other words, is a plant peculiarity, and when this variety is crossed upon sweet sorts it does not show any xenia of those markings.

The "Calico" seed employed was mixed as to the color of the endosperm, some grains being white and others yellow, and this fact is prominently enforced by the starchy kernels that appear in the sweet corn; that is, some are plain white dent and others yellow. In the case of the "Calico" ears, many of the grains doubtless carry the sweet potency under cover of the starchy quality; the yellow and white grains are disposed without order on any ear, and the yellow as a rule is evident, excepting where the coat is solid red, in which instance a removal of the thin wall of the ovary by scraping or weak potash shows that the yellow or white endosperm is beneath.

When there are two sets of colors—one a plant quality expressed in all the grains, in some degree of similarity, and the other a seed character and working somewhat independently of the other grains and possible of immediate influence by the pollen, it is evident that complications will arise in a field of the crop that at first sight seem to be a striking illustration of utter confusion.

The ear (14) next to the solid red one has beaked grains, a peculiarity that is of the plant giving this shape to all kernels it may produce in one or a half dozen ears.

This mixing of so many una at the same time is not recommended in the breeding of corn, but it is one of the methods of studying some phases of the subject.

THE "VOORHEES RED-EGYPTIAN" CROSS.

Some years ago the "Black Mexican" was bred upon the "Egyptian," a slate-black upon a white, and one of the results is a variety ("Voorhees") with a distinct red color. In order to test the behavior of this red-grained variety in breeding it was crossed in 1907 with a large number of varieties and the following year eight blocks of corn were grown from the crosses thus secured. The dark grains from some of the ears of "Voorhees Red" upon "Egyptian" of the crop of 1908 were grown in block the past season, and five of the many ears are shown in the lower right-hand corner of Plate IV. Ear 16 is short, thick, with sixteen rows, bearing a few white grains among the slate-colored ones; ear 17 differs chiefly in having no white grains, but about ten per cent. that are pink-blue, alike in themselves, pink, but in striking contrast with the other kernels, which are slate colored. Ear 18, long, blunt pointed, has both the white grains of the first and the pink of the second scattered throughout the somewhat variable slate grains. In ear 19 there is a larger percentage of white grains, and the others range from those tinged with lilac to the full slate. Practically the same state of things exists in the last ear (20). It seems likely that by isolation these colors could be secured, namely, white of the "Egyptian" and the black of the "Mexican" and the red of the "Voorhees."

EXPERIMENTS WITH SQUASHES.

Much of the land occupied by squashes was newly acquired, called the "North Lot," and this with the strips, where peas and beans were grown as a first crop, the area in squashes was fully two acres. On May 28th the bush squashes were planted in manured hills four feet apart, and the vine sorts eight feet each way.

The work was in immediate charge of Mr Shore, whose lamented illness and death prevent more than an incomplete record of the results. Following are some observations drawn from the notes taken chiefly at the close of the season and upon the fruits which remained in place after the leaves had fallen.

SHAPE IN CROSSED SQUASHES.

The squashes are nothing if not variable in shape; orchard fruits are constant in form in comparison with them and the same is true of the other vegetable fruits, not excepting peppers, which possibly take the second place.

Attention for the present is confined to the species *Cucurbita pepo L.*, and to the portion of it that takes the general names of summer squashes and pumpkins. In breeding together of these two groups, results have been reached that are summarized below:

The "Early Bush" (8) upon the "Field Pumpkin" (46) gave in the blend pear-shaped fruits more or less ribbed; in other words, a fruit resulted that approached an average between the flat of the "Bush" and the long oval of the "Pumpkin."

In the case of three-fourth blood of the flat scallop of the "Bush" the results show thirty-eight scalloped to five oval, and when the reverse is true, namely, three-fourth "Pumpkin," the forty-eight plants showed no true scallop—thus of the eleven with a shell there were recorded three as flat and one intermediate. The fifty-six plants of the reciprocal of the last, the total blend of "Pumpkin" remaining the same, the results were practically identical; that is, the shape was generally oval.

In the crosses of the "Mammoth White Scallop" (10) upon "Field Pumpkin" (46) the fruits were quite uniformly a scallop oval, thus striking an average between the two forms.

When the above cross was bred upon the "Scallop" the results show a large scallop fairly uniform throughout the thirteen hills. The reciprocal of this double cross (10//10/46) showed more variation, namely, scallop 11, oval 22 and intermediate 32. The row of (10/46//46) was remarkable for the heavy crop of fine orange pumpkins, with an occasional fruit inclined to be flat and showing other signs of the scallop "blood."

The cross of "Mammoth White Scallop" upon "Strickler's" (10/11) was bred upon "Cocoanut," a vine squash so named because the fruits are the shape (and size) of a cocoanut deprived of its fibrous coat. The record book shows that of the twenty-nine plants, thirteen had flat scalloped fruits and sixteen were oval. When the above double cross was bred to the "Cocoanut" again the shape generally was that of the "Cocoanut," there being but one plant with flat fruits. A reciprocal of the last compound cross showed eighteen oval and three flat sets of fruit.

The compound cross expressed by the form 11///10/11//19 gave a very fruitful row of thirteen hills with the fruits all broad straight-neck. When one of the "Strickler" is replaced by a "Scallop" and the record formula becomes 10///10/11//19, the fruits are all with a scallop. The "Cocoanut" shows its presence in the color, which for the present is purposely kept out of consideration.

The "Strickler" and "Cocoanut" (11/19 I) in their first generation showed in shape thirty-four plants with long fruits to fourteen with the "Cocoanut" strongly in evidence. Another row with the breeding within the mother plant, the results were long, 42; round, 5. The long is very potent over the round form.

By breeding the above cross to the "Cocoanut" as expressed in 11/19//19 the results were, 32 long, 35 round. The reciprocal of the last (19//11/19) gave, long, 29; round, 19. In many of the above combinations the actual shape of the fruits is such that no two plants have them alike. Each plant has its own fruits fashioned after the same pattern, so that by leaving one fruit upon each plant all the other fruits might have been most thoroughly mixed up and then returned to the plants that produced them. This fact indicates that the fruit shape (and size, color, marking and other peculiarities as well) is a plant characteristic and not one belonging exclusively to the particular fruit in which it finds expression.

The general shape of the squash fruit seems to be controlled by that of the stem of the plant, which as rule is five sided (pentagonal), and a section through it reveals ten strands of fibres (fibro-vascular bundles) five of them being at the angles and the other five midway between. The stem of the fruit observes the same pentagonal outline with modifications, and at the place where it joins the fruit proper there are often ten projections, five smaller alternating with the larger and forming buttresses. In the scalloped fruits it is a simpler matter to see that the larger five points of the end of the fruit-stem stand opposite the grooves and the ridges are opposite to the minor points in the stem. A scallop squash of the simplest type—as regards the rim—has five projections with alternating depressions; when more complicated there may be small knobs alternating with the larger ones or they may be in pairs between the original five. Whatever the increase in the number of scallops they are a multiple of five, and, as a rule, quite symmetrical, although during growth these, at first quite plastic, fruits may become warped from perfect regularity. For example, the under half of a fruit, unless quite small, is somewhat different from the upper half, depending upon greater pressure as it lies upon the earth as well as other varying surrounding conditions.

WEIGHTS OF SQUASHES.

But little attention was given to the productiveness of the various crosses. Weights, however, were taken of the fruits of some of the plants at the close of the season and at a time when the summer sorts with "shells" were not of table value. The following are some of the weights with the crosses preceding them:

	Number of Fruits to Plant.	*Weight. Lbs.*
1—Early Bush-Field Pumpkin (8/46 I)	8	9½
2—Early Bush-Early Bush/Pumpkin (8//8/46)	5	39½
		15½
3—Early Bush-Pumpkin/Pumpkin (8/46//46)	1	14
		16
4—Mammoth White Scallop-Pumpkin (10/46 I)	3	14¼
		10½

	Number of Fruits to Plant.	*Weight. Lbs.*
5—Mam. Wh. Scallop/Pumpkin-M. W. Sc. (10/46//10) ..	5	21¼
	3	11½
	1	5¾
	2	12¾
6—Mam. Wh. Scallop/Strickler's-Cocoanut (1/11//19) ...	5	6¾
	6	6¼
	5	9¼
	2	4½
	4	4¾
	3	4¼
7—The last upon Cocoanut (1/11//19///19)	3	5¾
	4	5¾
	2	4½
	5	4¼
	3	6¼
	5	4¾
	3	3¾
	2	3¼
	3	2¾
	3	4¼
8—Strickler-Wh. Scallop Strickler Cocoanut	1	5¼
	2	8
	1	6½
	2	11½
	3	8¼
	5	18¾
	4	33½
	5	25¾
9—Strickler-Cocoanut (11/19 I)	1	5½
	3	4¾
	5	6¼
	2	6
	2	11¼
	3	4¾
	5	7¼
	2	6½
	2	6½
	4	7
	3	6¼
	5	8¾
	2	6
10—Cocoanut/Strickler-Cocoanut (19//11/19)	8	9¼
	1	5¼
	1	4¾
	2	5¼
	3	4½
	3	4¼
	2	7¼
	1	3¾
	1	4½
	2	4¼

	Number of Fruits to Plant.	*Weight. Lbs.*
11—Strickler-Strickler/Cocoanut (11//11/19)	1	4¼
	2	8½
	1	5¾
	2	4½
	1	4¾
	2	7½
	1	5½
	2	5¾
	1	4½
	2	8¾
	1	4
	2	7
12—Fordhook/Fordhook-English Marrow (38//38/36)	7	24¼
	7	35¼
	5	20
	8	28
	5	18
	5	22
	13	29
	11	14
	5	15
	8	18
	13	46½
	10	33½

If one selects the No. 9 where there is quite a range in number of fruits upon a vine it is found that the average weight per fruit varies as follows:

	Weight—Lbs.
One fruit to plant	5.50
Two fruit to plant	3.62
Three fruit to plant	1.75
Four fruit to plant	1.75
Five fruit to plant	1.50

These are figures that lead to the general statement that the size of any particular fruit may depend upon the number borne by the same plant. In the case of the tenth group it is seen that the size of the fruit descends from 4.55 pounds for the average of the single fruits through 2.82 for the pairs and 1.46 for triplets to 1.16 for the vine with eight fruits.

In the case of No. 11 when as a rule the number of fruits was either one or two to each bush, it is found that six plants with single fruits gave 28.75 pounds—an average of 4.8 pounds and the six with two fruits yielded forty-two pounds—an average of

3.5 pounds. This result is in the range between a half and double of the weight of the fruits borne singly.

In group 12 the yield per vine was high, with a great range in weight, from fourteen to forty-six and one-half pounds. In this case the plants of varieties widely different in average size of fruit were crosses and it was evident at the weighing time that each vine had its fixed size of fruit, some favoring the smaller parent ("Fordhook") and others the larger ("English Marrow"). This row of vines came to full maturity, and, as a rule, the fruits of any one vine were all of the same size and shape. It is quite evident that from a field of squashes, each row of which represents a cross of often widely differing sizes of fruits, there is no satisfactory opportunity of determining the relation that exists between the size of the fruits and the number that a given plant produces.

COLOR IN CROSSED SQUASHES.

The colors in squashes are quite various, but may be grouped for study under the white, cream, lemon, yellow, orange and green. Some varieties have solid colors, but a majority carry two or more and possibly all the above colors arranged in bands, stripes, blotches, &c., thus adding to the confusion in this regard that reigns among the crosses of certain varieties.

In the "Early Bush" upon "Field Pumpkin" (8/46 I) the fruits were all light cream colored. They, as expected, were the same when the "Bush" was three-fourths, but in the reciprocal (8/46//46) the cream, yellow, orange and green colors were represented.

The "Mammoth White Scallop" and "Field Pumpkin" (10/46 I) showed eight cream, eleven lemon, seven orange and six green. In the 10/46//10, the fruits were all cream, while the reciprocal (10//10/46) had thirty-three cream and thirty-two lemon. The 10/46//46 had a large row (thirteen hills) of solid orange pumpkins and the reciprocal 46//10/46, while a less prolific row, otherwise agreed closely with the last, excepting that there were two vines with beautifully mottled green and cream flat fruits.

A row of 46///5/6//11 I gave twenty-nine orange, five green fruiting vines.

In the compound cross of 10/11//19 I there were thirteen solid cream and sixteen of orange (usually with various green markings).

When the above was bred to the "Cocoanut" (19) 10/11//19///19, there were seven cream, four striped and one with a green tip. The reciprocal of the last produced eleven cream, six striped orange-green and four orange with a green tip. When "Strickler" was crossed upon the 10/11//19, making 11///10/11//19, the green did not appear and there were thirteen cream and twenty-three striped light orange upon cream background.

In the compound of 10///10/11/19 there were thirty cream and seventeen green (some solid and others with blotches of yellow and variable upon the same plant). The 6/5//19///19 gave thirty-four cream, thirty-two orange striped with green, and 6/5//19///6/5 produced thirty-two cream, twelve with orange striped upon the cream bush grown. In 6/5///6/5//19 there were sixteen cream and twenty-one orange striped.

The "Strickler" upon "Cocoanut" (11/19) yielded seventeen orange and seventy-nine striped with green. In the 11/19//19 there were twenty-seven orange, twenty green striped, twenty green tipped, and in 19//11/19, twenty-six orange, nine green striped and twelve green tipped. In the 11//11/19 there were eighteen orange and thirty green striped. (The two groups of green were not represented, but in the note book records there were fruits with green tips present.)

In the "Golden Bush" upon "Bush Fordhook" (9/51 I) there were thirteen cream and ten orange; when 9 was added in 9/51//9 there were twenty-four cream and twenty-four orange with the reciprocal 9//9/51, giving twenty-six cream and twenty-seven orange.

The 9/51//51 gave all thirty-six cream, and 51//9/51 produced twenty-one cream and six orange.

The "Michigan" upon "Mammoth White Scallop" (53/10 I) produced forty-eight cream (lemon-cream), thirteen green, six striped; when the "Michigan" made up three-fourths (53/10//53) the fruits were all green and represented closely the "Michigan" parent, but the reciprocal (53//53/10) gave eight green and thirteen cream. The 53//10//10 gave nine green and twenty-three cream, while 10//53/10 yielded two green and twenty cream.

Among the bush crosses the "Golden Bush" upon "Cocozelle" (9/52) orange upon green gave six orange, nine striped (orange and green) and two green. Another row of the same cross with different mother fruit yielded seven orange, nine striped and eight green.

The "Mammoth White Scallop" upon "Bush Fordhook" (10/51), a white upon a pale salmon, gave forty-two lemon and fourteen cream and a second row from a different mother fruit yielded seven lemon and thirty-six cream.

The "Strickler" upon "Michigan" (11/53), orange upon green, produced sixteen orange and eight green.

Much difficulty is experienced in classifying squashes that have green in them because of this color disappearing more or less with age. Thus a fruit having only green when full sized may become striped or those stripes may fade out and the basal orange or cream occupy the whole surface. The green colored fruit may show a yellow or orange only when the fruit rests upon the ground. There are instances quite the opposite to this when the remaining green portion is the under side when light is excluded, and such have been seen to lose the green when the shaded part is given full exposure to the light.

CONCERNING THE SHELL IN SQUASHES.

Many kinds of squashes as the fruits mature have a hard coat formed between the skin and the flesh beneath. In some members of the squash family the wall of the ovary is chiefly transformed into this hard layer, as instanced in the multiform gourds, many of which for this reason are fashioned into various utensils.

When squashes having the power to produce a shell are crossed with those lacking in this peculiarity, the offspring vary greatly in shell production. Thus when the "Early Bush" (8)—a small flat scallop, white shell—is bred with the "Field Pumpkin" (46)—a large, oval, yellow vine variety without a shell—the results are variable as regards the shell as shown below:

		Shell.	*No Shell.*
1—	E. Bush//E. Bush/F. Pumpkin (8/18/46)	38	5
	" /F. Pumpkin//F. P. (8/46//46)	11	37
	F. Pumpkin//E. Bush/F. P. (46//8/46)	11	46
2—	Mam. Wh. Scal. F. Pumpkin (10/46 I)	Indistinct.	
	" " " / " (10/46//10)	All.	
	" " " "/ " (10//10/46)	35	31
	" " " "/F. P.//F. P. (10/46//46)	None.	
3—	Mam. Wh. Scal./Strick.//Cocoanut (10/11//19)	Indistinct.	
	Cocoanut///Mam. Wh. Sc./Strick.//Cocoanut (19///10/11//19)		All.
	Strick.///Mam. Wh. Sc./Strick.//Cocoanut 11///10/11//19)		All.
	Mam. Wh. Sc.///Mam. Wh. Sc./Strick./Cocoanut (10///10/11/19)	30	26
4—	L. I. Scal./C. Neck//Cocoanut (6/5//19 I)	29	21
	L. I. Scal./C. Neck//Cocoanut//Cocoanut (6/5//19///19)	24	42
	6/5//19///6/5	42	0
	6/5///6/5//19	35	6
5—	Mam. Wh. Sc. Bush Fordhook (10/51 I)	29	17
6—	Strickler/Cocoanut (11/19 I)	143	62
	" " " (Within plant)	33	14
	" " /Cocoanut (11/19//19)	35	33
	Cocoanut//Strick./Cocoanut (11//11/19)	23	23
	Strickler//Strickler/Cocoanut (11//11/19)	48	0
7—	Michigan/Mam. Wh. Sc. (53/10 I)	47	20
	Mich./Mam. Wh. Sc.//Mich. (53/10//53)	9	15
	Mich.//Mich./Mam. Wh. Sc. (53//53/10)	38	24
	Mich./Mam. Wh. Sc.//M. W. S.//(53/10//10)	19	13
	M. W. S.//Mich./M. W. S. (10//53/10)	17	5

In the first group it is noted that when the "Early Bush" represents three-fourths, the fruits are nearly all with shell and the reverse is true when the "Field Pumpkin" is three-fourths.

In the second group with the "Mammoth White" three-fourths all the fruits are with shell, and the exact reverse is true when the "Pumpkin" is three-fourths. With the two parents equally represented there is an indistinct shell.

The third group shows that there was an imperfect shell with the "Cocoanut," representing a quarter and more when it is a half. Again with the "Strickler" half with "Mammoth" and "Cocoanut" for the other half there is a well developed shell in all crosses, and in the last set where "Mammoth" is a half, there is a nearly even division between the shell and no shell.

In number 4 the effect of the "Cocoanut" is noticed in all excepting the third combination. The shell producing force is stronger than the non-shell forming power.

This last fact is very evident in the next three instances, which, when combined, show that with equal parts of shell and no shell the progeny shows 205 shell to ninety-three non-shell producing plants. Thus it is seen further on that "Strickler" is able to hold its shell evenly when "Cocoanut" is three-fourths and when "Strickler" is three-fourths—all the fruits are with shell.

In number 7 there is a large representation of a shell and no-shell sort, and the figures here further show that the "Mammoth" even when represented by only one-fourth is able to produce 61 per cent. of plants with shells to the fruits.

The subject of the shell has not been studied with the compound microscope, and the test, when so many fruits were represented, was necessarily crude and consisted in thrusting, or attempting to thrust, a sharpened nail fitted into the end of a cane into the flesh of the squash.

By assembling all the above instances where the two factors are evenly balanced and results decisive it is found that the shell to the non-shell is as 152 to 113.

THE "STRICKLER-COCOANUT" CROSS (11/19).

There were three rows of fourteen hills each of the blend of the "Strickler" upon the "Cocoanut." This is the union of a long, large, often bent-neck, warted, dark orange shell, bush summer squash with a nearly round, grooved, small belted green tip, or variously striped green, light orange and cream vine winter squash.

The following table shows some of the facts that were drawn from the study of the plants that bore fruits of marketable size:

Bush	87	Shell to fruit..	56	No shell..	31	Striped..	75	Orange..	12
Half vine..	69	"	48	"	21	"	54	"	15
Totals..	156		104		52		129		27

It is seen that somewhat more than half were bush plants. The term "bush" and "half-vine" are convenient terms, but not here used with any exact meaning. A bush is a plant with a stem averaging two and one-half feet in length and a half vine with a prostrate stem five to ten feet long. The present figures were obtained in particular from the plants after the leaves had fallen and the prostrate stems could be easily measured. As a matter of fact, in blend plants like these between a true bush and a regular vine squash there is great difficulty in the above classification. The vines were all short; that is, none of them exceeded the ten-foot limit set for convenience as the length to be obtained under normal conditions of the "cocoanut" plant. In other words, the bush type dominated very fully, and one needs to observe the lengths of the stems of the plants that follow in the next generation to get the necessary facts as to this unum.

It is seen that there is nearly the same per cent. of shell fruits with the bush as the half-vine plants. It is noted that the number with shell is just double those without the shell. In the matter of this hard cover at maturity there is range from those with a shell a quarter of an inch thick to others with only a thin protection. The test was made with an awl that was thrust into the flesh of the squash, and the decision was made upon the amount of resistance to the passage of the awl.

A division was attempted upon the basis of color of the bush, the deep solid orange of the male parent being for one group and those not showing this for the other. The latter exhibiting a great variety of stripes and blotches of green and orange, including those with a green area at the blossom end of the fruit. A little more than a fifth of the fruits were of the pure deep orange type and suggests that there is a unum that might adhere to the Mendelian rule.

Of the many other peculiarities, as size and shape of the fruits, little can be set down with any degree of satisfaction at present. The cross involved many characters and it is impossible to establish any rule for any single quality, without having a much larger number of instances.

CONTINUOUS SELECTION OF TYPES.

The "Jersey Green" is a summer squash that has been secured in four years of selection from a cross of the "Yellow Crookneck" upon the cross of the same variety with the "Cream Scallop," and represented by the formula 5//6/5. The first generation gave generally smooth "Jugs," but variable in color. Smooth green "jugs" were selected for seed, from which came seven types; from these the smooth green-fruited plants were selected and bred to themselves and within the particular plant. In 1908 this work resulted in a block of plants upon the home grounds, all of which were green fruited. A distribution was also made the same year of the seeds of the previous crop under the name of "Jersey Green," and forty-three individual responses are recorded in the annual report for last year, pages 255, 256.

During the present season a test was made of planting separately seeds of this sort that resulted from fertilization within the plant, and all the thirteen hills showed feeble plants that matured usually not more than a single fruit while these were in all cases true to type.

Alongside of this test of the "Jersey Green" were rows of other types of summer squashes, the seeds of which came from the breeding within the plant, and in every case the results were the same, namely, very feeble plants. This block of rows of squashes was very noticeable because of the lack of vigor, and it is regretted that a field photograph was not taken, showing the striking contrast between the rows grown from closely bred seed and those without this inbreeding.

It was determined that quite minute features of a squash fruit can be fixed by this process of breeding within the plant. Thus there was one row planted with seed from a peculiar "acorn" formed fruit, fertilized within the plant, and all the many fruits were alike in this respect. Another row was planted to another variation of the "acorn" and the result was the same. Still another row had a third "acorn" peculiarity, and this in like manner was reproduced and apparently will remain fixed so long as the breeding is confined to plants with that peculiarity.

One row was planted with seeds from a fluted "jug" with certain pale green strips, and both the shape and the stripes came true to the parents. In the same way a large orange "jug" produced all orange fruits with some variation in the shape. In the case of a smooth cream "jug" the results were uniform in color, but some variation in the shape. These experiments indicate that shape is more subject to change than color. There are comparatively few colors and their combinations, but in shape there are almost infinite variations from the round to the club, and particularly when the two extremes meet in the "jug" type.

There were three rows of the "Fluted Orange" in this test of close breeding. This variety resulted from the breeding of the "Strickler's Summer" upon the "Golden Bush" (11/9) in 1905. During the first year the fruits were all yellow "jugs;" by selection a scalloped rectangular type was reached, and the next year a uniform set of long orange fluted fruits was obtained. Seeds of this sort were distributed in 1908, and the results of the testers reported last year. The three rows planted with inbred seed the present season showed a close adherence to the form of the parents and a failure from the commercial point of view.

All the tests above considered agree in the uniform fixation of parental peculiarities, but at the same time a weakness is developed that is most striking.

Experiments with Eggplants.

During the third week in May, Series II. was set to eggplants, save a portion of Plot 2 reserved for corn. There were represented 233 hybrids, 200 "American" crosses and 158 "Commercials," making a total of 591 plants. The midsummer drought was a severe check to the growth of the crop and small plants and yields resulted.

The blends grown for the first time this season are figured in Plate V. The combination of "Long White" upon "Dwarf Purple" (11/6) shown at 2, produced a purplish spiny fruit, with the general form of (6), with the light green surface under the calyx of that parent, and exceeded the mother in length and size. This cross gave an average of eight fruits per plant, the fruits

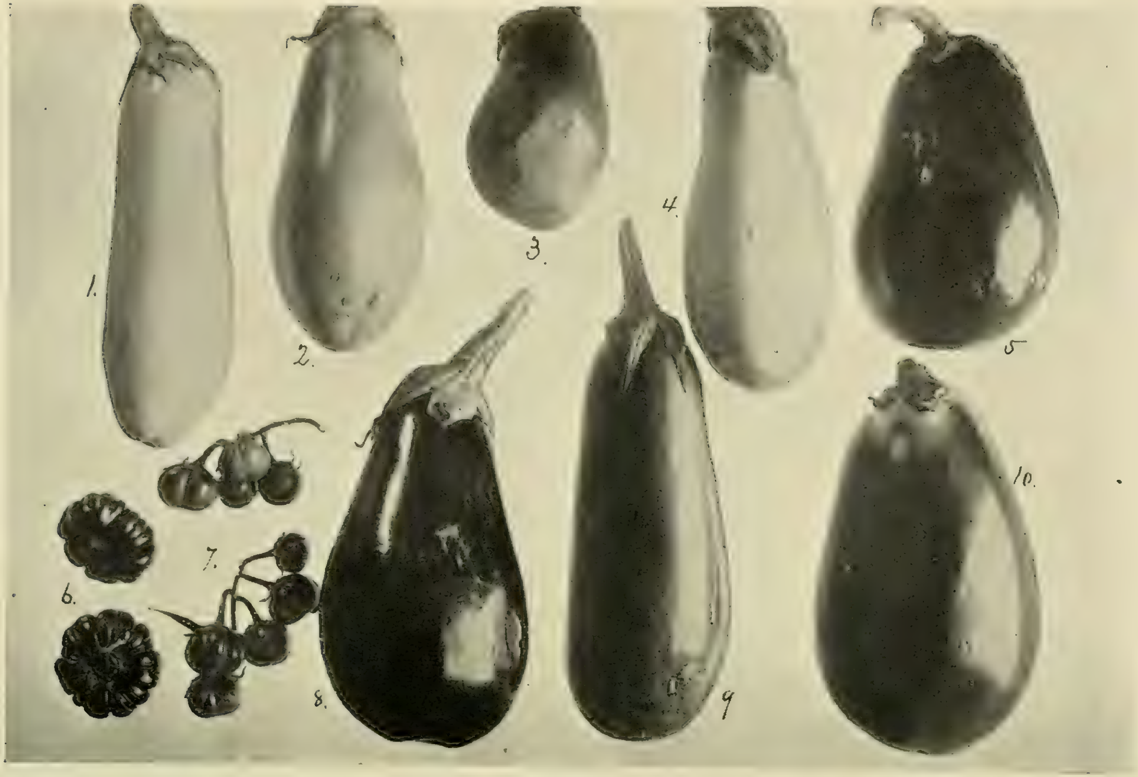

1.
2.
3.
4.
5
6.
7.
8.
9
10.

PLATE V.

Crossed Eggplants—Some of the new crosses of the previous year are shown.

weighing on an average eleven ounces, with a keeping quality of 66 per cent., estimated from the number of fruits free from decay upon October 26th, no picking being done in the keeping test.

The blend of "Ivory" (26) and "Mammoth Purple" (13), shown at 5, has inherited size and color from the female, while the "Ivory" shaped its form to that of the "Jersey Belle." ("Mammoth Purple" is not figured, as it could not be obtained.) The average number of fruits per plant was 5.5 and keeping quality 13 per cent.

The striking hybrid at 7, a result of combining "Scarlet Chinese" (25) and "Upright" (31), illustrates in a forcible manner the dominance of the male parent. The average number of fruits per plant was fifty, weight of single fruits, .3 ounces and keeping quality 100 per cent.

The fruits at 10 represent a blending of the "Jersey Pink" (28) and "Purple Tokio" (32), the latter (which resembles "Black Pekin" (3) in everything but size) not being shown in the plate. In size, form and color the offspring is a medium between the two parents, while the light green surface under the calyx shows the influence of the mother parent. The average number of fruits per plant was 7.3, average weight of fruits for ten plants, two pounds, keeping quality 66 per cent.

CROSS.	Number of dark fruited plants.	Number light fruited plants.	Number spiny plants.	Number of spineless plants.	Average number fruits per plant.	Oct. 26th—Not decayed.
2/5 III	10	..	7	3	10.8	45 %
2/5//29 I	2	8	7	3	9.1	34 "
2/5//29///32	5	..	5	..	9	68 "
2/5//29///6//25/6	5	..	5	..	18.4	41 "
2/29 I	7	6	5	8	7.6	53 "
2/6///2/5//29	9	..	9	..	5.5	8 "
3/11 I	9	16	25	..	5.1	24 "
3/11//4	5	..	5	..	5	32 "
4///2/5//29	5	..	5	..	5.8	17 "
4//2/18	4	..	4	..	3	41 "
4//2/29	10	..	10	..	4.6	45 "
4///6//25/6	5	..	5	..	7.2	16 "
4///10//3/2	5	..	5	..	8.3	30 "
4///10/6//14/25	4	..	3	1	15.7	79 "
4///10//6/19	5	..	5	..	6.3	18 "
4//25/6 B–4	13	..	9	4	5	77 "
6/19 II	23	..	23	..	....	75 "
6//25/6	48	..	48	..	10.4	61 "
6//25/6///10/29	3	2	5	..	8.2	45 "
6//25/6///21//6/19	10	..	10	..	8.7	86 "
6/25	4	1	4	1	7.4	89 "
6//25/6///28	1	..	1	..	24	100 "
10//2/5 I	5	..	5	..	8.8	63 "
10//6/19 I	3	..	3	..	8	50 "
10/6//14/25	15	1	11	5	8.5	59 "
10//14/25///2/5//29	13	1	13	1	6.5	54 "
11/4 II	14	..	14	..	6.9	78 "
11/6	8	..	8	..	8.1	66 "
11///10/6//14/25	12	..	12	..	6.9	62.7 "
13//2/29	4	..	4	..	5.2	40 "
16///26//14	6	..	6	..	8	91 "
21//6/19///14/25	8	..	8	..	7.5	65 "
21//6/19///25/6	4	..	4	..	9.5	31 "
25/6	16	3	17	2	6.7	71 "
25/31	..	3	3	..	50.6	100 "
26//2/5///28//10/6	5	..	5	..	11.6	62 "
26//10/2 L	6	4	10	..	10.8	35 "
26/13	4	..	4	..	5.5	13 "
26//14/25	16	..	16	..	12.2	56 "
27///10//2/5	9	..	9	..	9.5	27 "
28//14/25	11	3	12	2	15.1	59 "
28//10/6 I	3	1	4	..	13.5	37 "
28/32	6	..	6	..	7.3	59 "
31//14/25	1	..	1	..	16	100 "
32///6//25/6	10	..	10	..	10.1	68 "
32///10//2/5	4	..	4	..	8.5	50 "

The four crosses, 2/29 I, 2/5//29 I, 3/11 I and 26//10/2 I, were combinations in each case of a white and a purple fruit and were represented by fifty-eight plants, twenty-four of which bore purple and thirty-four white fruits.

Certain plants of the "Black Pekin"-"Long White" cross (3/11) gave greenish white fruits with the form of "Pekin," a novelty which might be called "Green Pekin." The "Black Snake-Round White" (2/29) likewise gave the "Green Snake."

One dwarf plant of "Black Snake-Dwarf Purple-Round White" (2/5//29) produced fruits of the "Dwarf Purple" form with white of the "Ivory" giving the "Dwarf Ivory."

"Scarlet Chinese" heads the list in number of fruits per plant (65.8), the "Commercials" averaging the lowest (6.2).

The heaviest fruits were found among the blends, followed in order by the "Commercials," the later generation crosses and the ⅞ and ¾ hybrids, respectively.

KIND OF PLANT.	Number of plants.	Average number fruits per plant.	Average weight of fruit.	Oct. 26th.—Not decayed.	Number of spiny plants.
American varieties	146	6.2	15.9 oz.	40.6 %	96.1 %
Blend crosses	88	6.5	26.6 "	38.4 "	100 "
Later generation	145	8.9	14.5 "	49.4 "	88 "
⅞ American	53	11.2	9.2 "	66.2 "	96.9 "
¾ "	120	10.3	8.4 "	63.5 "	90.8 "
½ "	27	21.5	3.2 "	86.6 "	88.8 "
"Chinese" (Chameleon)..	12	65.8	1.2 "	96.5 "	41.6 "

The above is a summary of the preceding table, indicating that the "Chinese" stands highest on the list in number of fruits per plant, followed by ½, ⅞ and ¾ hybrids, while the "Later Generations" exceed the blends by 2.4 fruits per plant. In "average weight" of fruits, the "Blend Crosses" stand highest, and the ⅞ "American" gives an average only .8 oz. greater than the ¾ "American." The "Chinese," as might be expected, lead in "keeping quality" followed by ½, ⅞ and ¾ "American," respectively.

The eighty-eight plants of the "Blends" were all spiny and 96.9 per cent. of the ⅞ "American." There is hope that the spineless type can be secured by careful selection and breeding of spineless plants.

Plate VI. represents the base of a ⅞ hybrid plant with a wire label attached, showing that the following line of breeding has been carried out. The "Chinese" (25) fruits, of which are shown at the lower right-hand corner, was bred upon the "Dwarf Purple" (6) (shown at the lower left-hand corner). The "Black Snake" (2) sample fruit at upper left-hand corner was bred to "Dwarf Oval" (5)—practically the same as (6). This last cross (2/5) was bred upon the "Round White" (29), shown at upper right-hand corner, while at the same time the "Dwarf Purple" was bred upon the hybrid 25/6, giving the ¾ hybrid 6//25/6. Last of all these double crosses were bred together as shown by the label in the following formula, 2/5//29///6//25/6. As 25 is the only "Chinese" and this is used but once, the amount of its "blood" is one-eighth of the whole; that is, with the (6) it was first reduced to a half, and with (6) again to a quarter, and then when this quarter "blood" was bred upon by 2/5//29 (they being all "American") the "Chinese" was reduced to one-eighth, or in other terms a ⅞ "American" is represented in the plate.

Plate VII. represents fruits of promising plants of the ⅞ hybrids. All are purplish at the marketable stage, shading to a dull "russet orange" when mature. The fruit at 1 is the result of uniting with the "Scarlet Chinese" (25) the varieties "Black Beauty" (4) and "Dwarf Purple" (6), the fractional record being 4///6//25/6. This means that "Chinese" was first crossed upon "Dwarf Purple" and the following season the latter (6) was bred with the ½ hybrid (25/6), giving the ¾ hybrid (6//25/6). The ⅞ hybrid (4///6//25/6) obtained by further breeding (1908) with the "Black Beauty" (4). The fruit in question has the general form of (6) with an increased size due to the influence of (4), while in length it has outstripped both parents. The fruits at 2 and 3 of similar origin, were produced by the union last year of the ¾ hybrid (6//25/6) with the cross "Jersey Belle"-"Round White" (10/29), expressed by the fraction 6//25/6///10/29. They have lost the pear shape of (6), "Jersey Belle" and "Round White" adding size and "plumpness." At 4 and 5 are shown results of combining the same hybrid (6//25/6) with the cross "Striped" (21), "Dwarf Purple" (6), "N. Y. Improved" (19), the complete fractional record being 6//25/6///21//6/19. In this instance "Dwarf Purple" is represented three times, its influence on form being well shown at 5. "Striped" resembles "Round White" in shape, accounting in part for the resemblance of (4) to

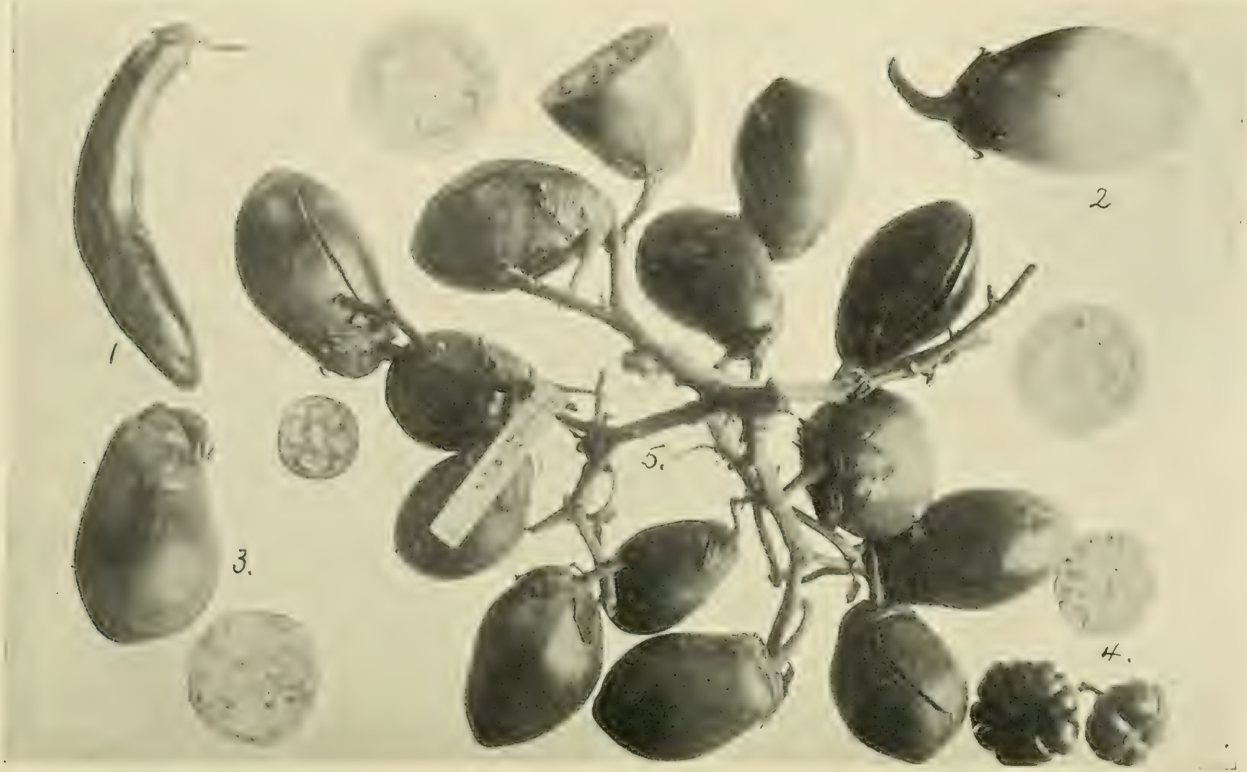


PLATE VI.

Hybrid Eggplants—The base of a plant of a hybrid between "American" and "Chinese" eggplant is shown in the center (5) with sample fruits of the four parents in the corners. Namely, 1, "Black Snake;" 2, "Round White;" 3, "Dwarf Oval," and 4, "Scarlet Chinese."

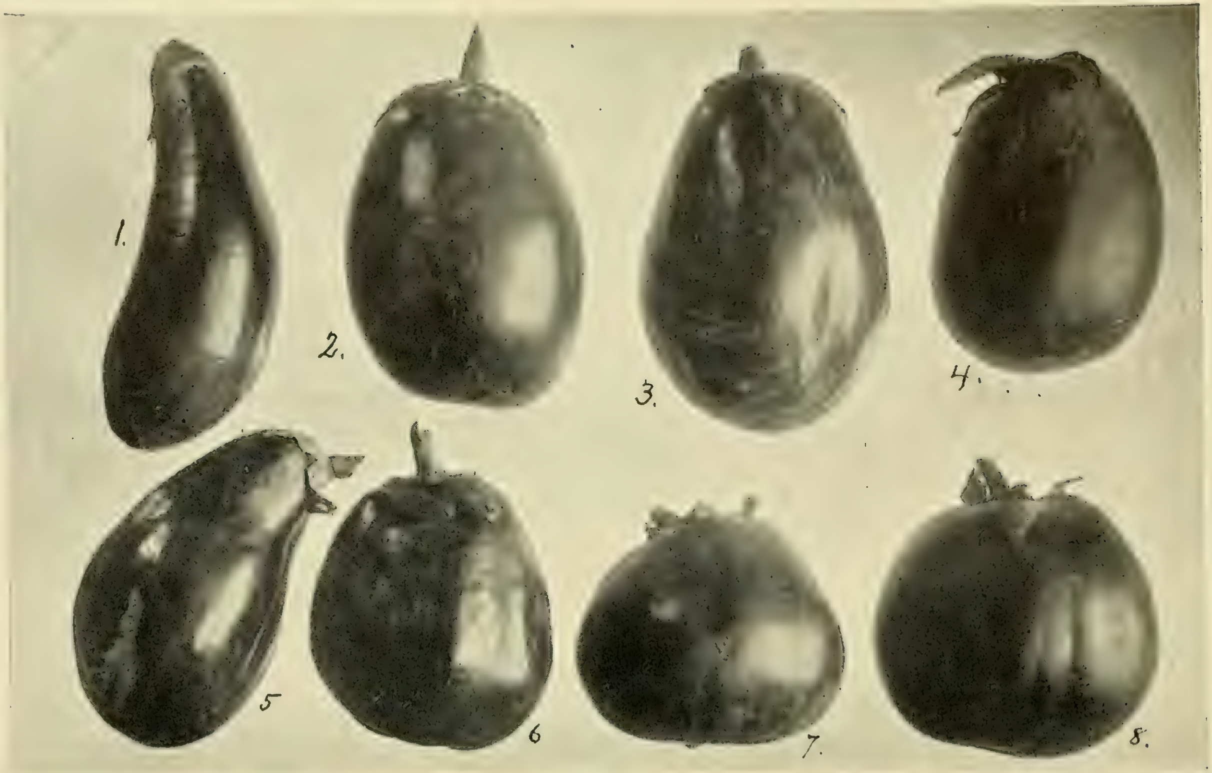


PLATE VII.

Hybrid Eggplant—Sample fruits of the "American-Chinese" with the "Chinese" reduced to one-eighth to secure firmness of flesh and consequent keeping quality with freedom from bitterness.

(2) since the parentage of (29) is expressed in the fruit at 2. The last three fruits shown at 6, 7 and 8 are of similar parentage, being obtained by crossing "Purple Tokio" (32) upon the ¾ hybrid (6//25/6). "Tokio" is round-fruited like the "Black Pekin," and has reduced the length of its offspring, producing a flattened oval fruit. The specimen at 8 shows the light green surface under the calyx, a character both of "Purple Tokio" and "Dwarf Purple."

Those who tested the ⅞ hybrids for table quality pronounced them equal in texture and flavor to standard sorts with no trace of bitterness peculiar to the "Chinese." Further crossing with desirable varieties has been continued this year in the hope of obtaining a 15/16 hybrid with a normal-sized fruit of good quality and more desirable in market because of greater resistance to decay.

NOVELTIES.

Two new varieties of eggplants were tested the past season. No. 34, *"Round Purple."* Four plants were grown, with an average height of one and one-half foot, purplish stem and foliage and purple fruit, which in form did not bear out its name, being less "round" than the "Black Pekin." The average number of fruits per plant was seven with a keeping quality of 28 per cent.

No. 35, *"Chameleon."* This novelty represented by eight plants had the general habit of "Scarlet Chinese," but with the exception of one plant was spineless. The stem and foliage were green, height of plant, two and one-half feet, with smooth egg-shaped fruits—glossy green until near ripening when they changed to shades of orange, which explains the varietal name. Six hundred and forty fruits were counted at harvest; keeping quality, 98 per cent. This is doubtless a selection of the "Chinese," and promises to make a better breeder than the old form.

EXPERIMENTS WITH TOMATOES.

Twenty-five hundred tomato plants were grown in the home grounds during 1909, occupying the greater part of Series III. and IV. About one hundred combinations in breeding were under observation, representing several lines of research.

BREEDING FOR LENGTH.

The most promising plants of the "Selected long" crosses were bred last year within the plant, and from seed thus secured this season's representation showed an increased uniformity in the shape and size of the fruit. There is still a lack in size before the "goose-egg" type of tomato can be placed in competition with the "flat," "apple" or "globe" sorts.

In this branch of breeding the best results have come from a combination of a variety with a long polar axis to its fruit with one that is nearly round and having a thick flesh and firm interior. Thus the "Magnerosa" (227) bred with "Sumatra Fig" (181), "Magnus" with "Globe" (194) and "Giant" (56) with "Globe" have given in each case pink fruits of fine interior and approaching the form desired. At the time of writing the most approved cross has the following formula: 227///103//103/181. This means that the "Ponderosa" (103) was bred upon the "Sumatra Fig" (181), and upon this cross the "Ponderosa" was again bred and finally with this the "Magnus" upon "Ponderosa" derivative.

The "King Humbert" (64) is a long-axis variety with only two or three cells to the fruit and altogether is flabby and undesirable. Its chief and almost the only good quality, in this connection, is its length, and in striving for that in the cross one is quite certain to secure a fruit that is misshapen with much work in store to build it into a solid smooth "goose egg." After using the "Humbert" quite freely nearly all its crosses have been discarded as too troublesome.

A STUDY OF THE SEED CAVITIES.

The number of seed cavities (locules) in several kinds of tomatoes was determined by cutting the fruits through their equatorial diameter. In the following table the one hundred instances for each kind are arranged in their appropriate columns. For example, "Frogmore" has 56 per cent. three-celled, while "King Humbert" has 92 per cent. two-celled. "Jewel," "Magnus" and "Globe" have the largest number, five-celled. The "Ponderosa" has none under six-celled and nearly all were over nine-celled.

In the double cross (130//103/181), when "Ponderosa" appears twice and "Sumatra Fig" once, it is seen that the number of cells in the mother fruit seems to have an influence, for when it was two-celled the offspring were sixty-nine two-celled and thirty-one three-celled, and when three-celled, there were some with three and four cells, while when five-celled the center of greatest percentage were around five-celled. The same is also seen in the 227 ("Magnerosa") where the only exception is the last lot, having a seven-celled mother fruit.

It is evident that a very extended application of biometry is needed before a rule can be derived for the development of the fruit interior.

VARIETY OF CROSS.	No. of Plants.	2-celled.	3-celled.	4-celled.	5-celled.	6-celled.	7-celled.	8-celled.	9-celled.	10-celled.	Over 10-celled.
"Frogmore" (55)	4	5	56	26	5	5	2	1	...	...	...
"Humbert" (64)	4	92	8	...	...	...	...	...	...	...	...
"Jewel" (66)	4	...	13	14	19	16	16	10	4	6	2
"Magnus" (75)	4	...	...	13	30	27	15	4	5	2	4
"Ponderosa" (103)	8	...	...	...	...	1	1	6	5	10	77
"Currant" (177)	1	99	1	...	...	...	...	...	...	...	...
"Red Peach" (178)	4	21	47	27	1	4	...	...	...	...	...
"Yellow Peach" (186)	4	36	55	8	1	...	...	...	...	...	...
"Globe" (194)	4	1	3	22	24	22	13	10	2	1	2
33/66	20	...	11	44	25	15	2	3	...	...	...
103//103/181 (2-C)	5	69	31	...	...	...	...	...	...	...	...
" " " (5-C)	5	56	35	7	2	...	...	...	...	...	...
" " " (5-C)	5	...	6	18	21	20	10	8	4	...	...
103//103/181/// 227//194/75 (2-C)	5	15	11	27	19	9	2	2	4	4	7
103//103/181/// 227//194/75 (2-C)	5	40	44	11	4	1	...	...	...	...	...
103//103/181/// 227//194/75 (4-C)	5	...	8	22	34	25	6	3	2	...	...
194/74	5	...	11	21	30	18	7	4	2	1	6
210/75	5	...	2	18	31	31	12	4	1	...	1
227 (3-celled)	5	7	51	27	9	1	3	...	...	...	2
" " "	5	1	38	30	17	10	2	...	2	...	...
" " "	5	...	40	42	12	3	2	1	...	...	...
" " "	5	2	18	41	26	11	1	1	...	...	...
" 4- "	5	1	13	37	32	13	3	1	...	...	...
" 5- "	5	1	12	42	20	9	6	4	3	...	3
" 6- "	5	...	8	30	24	18	13	5	2	...	...
" " "	5	2	18	32	33	9	5	...	...	...	...
" 7- "	5	6	46	30	13	3	2	...	...	...	...
227//33/66 (3-C)	5	1	30	37	26	4	1	1	...	...	...
" " " (4-C)	5	...	6	38	34	16	5	6	...	...	...
" " " (5-C)	5	...	17	20	25	18	3	2	3	...	...
" " " (6-C)	5	...	10	17	34	13	11	3	2	...	...
227//56/194 (3-C)	5	1	48	38	7	3	2	...	1	...	...
" " " (5-C)	5	5	39	33	10	7	4	1	1	...	...
227//56/194///103//103/181	5	15	59	18	5	1	1	...	1	...	...

THE "BABY PONDEROSA."

In 1906 the following double cross was made, namely, "Acme-Arcadia" upon "Currant-Ponderosa." The block of blend plants showed a striking range of variation in stem, foliage, flower cluster and fruit. There were two plants that had the fruits flat, somewhat ribbed, and in equational section showed many seed cavities; all of which led at once to the expression "Baby Ponderosa," since which the type has borne this garden name.

Seed secured from one of the above-named plants by close breeding has since produced a set of plants that is quite uniform in the character of the fruit. The vines are somewhat slender, long, and have a strong suggestion of the "Currant" type, easily recognized by the many small separate lobes of the leaves. In inflorescence there is a blending of the raceme of the "Currant" with the branched cluster of the "Ponderosa," and the whole plants are less hairy than the last-named parent.

The fruits of this hybrid are perhaps of but little value commercially, as they are too small, of poor shape (flat) and the walls of the seed cavities are thin and the seeds numerous. The flavor is different from any other tomato in the field, and to those who like a tartness in this fruit it is very agreeable, but, perhaps, the best judges would condemn it upon this point as well as the size.

The plants varied considerably in time of fruiting and prolificness, but in general the "Baby Ponderosa" is a midseason tomato and a good bearer. Owing to the thinness of the wall and the roughness of the exterior it is not a good keeper.

From the breeder's standpoint it illustrates that extreme forms may be combined and striking intermediate types secured in a short time by the process of selecting and inbreeding. It shows that in such a hybrid neither parent controls in the blend save where strictly Mendelian una are involved. In the present instance there were both the red of the "Currant" and the pink of the "Ponderosa" in the set of blend plants. In making the selection of the "Baby Ponderosa" a pink-fruited plant was chosen and that color has remained constant.

"PEACH-SALAD" TOMATO.

Perhaps the most attractive tomato plants in the whole area was a block of twenty-five with fruits like ripe, highly colored peaches. In 1905 the "Giant" was bred upon the "Globe" (56/194), chiefly to improve the interior of the fruit of the latter. In 1906 the "Magnerosa" (227), selected long and pink, was bred to the above cross, also pink and selected for length, thus giving the record formula of 227//56/194. Among the plants in the next year was one that showed much length and also the "peach" character of skin, and altogether made a very attractive fruit.

During 1908 a large number of plants were grown from seed worked within the "peach" plant, and they were all with the same characters as the parent, and differed chiefly in the size of the fruits. The plants having the most desirable fruits were bred together, and the present year five rows of five plants each were grown, three of which were from seeds that had been secured by breeding separately within the plant in each case in the greenhouse during the previous winter.

All of the plants showed more than average vigor and prolificness, and while there was some variation in size and shape and degree of "peachness" of the skin of the fruit, the block was easily recognized—surrounded as it was by various crosses upon all sides.

The fruits were quite light, almost white, before they developed the rich fine tints of the true peach, and considerably longer than the commercial varieties of the "Peach" tomato grown elsewhere for comparison.

Only a properly executed colored plate would do justice to the surface of the fruit of this cross, but the attractiveness does not stop with the skin, for of all the many blends in the field, none suffered as did this from continuous picking for immediate use; in other words, the fine pink flesh had a flavor quite its own that easily won it friends.

If the time had come when tomatoes are eaten out of hand like grapes it is reasonable to conclude that this sort would be one of the most attractive for such a purpose. Possibly it is too large, but there is but little fear in reducing the size of fruits, and with the stems of the cluster made glandless by breeding, this tomato would fill a place now little dreamed of. At no distant day the freshly picked tomato clusters may be served from the vines in the fruit dish and there need be no trouble in discarding the seeds as is the case with grapes. The above cross points the way to a greatly enlarged field of usefulness for the tomato. For growing in the greenhouse to be served whole, singly upon lettuce or otherwise, the tomato in question may well attract the attention of the grower and consumer, and this method of its use combined with its very attractive appearance suggests the name that has been given in the heading.

From the breeder's point of view it is possibly a regret that the way in which the original plant came into being is unknown. As plants of the commercial "peach" were in the field a stray pollen grain from them may have given the initiative; this seems a more rational explanation than that it was a mutant, but whatever view is held the result is a worthy acquisition among tomatoes.

A COARSE-LEAVED "PLUM" TOMATO.

In filling out the una scheme the task was the making of a sort, the fruit of which should be small, oval and borne by a plant with the leaves of the coarse or "potato" group. Nothing is here said as to the color of the fruit nor whether the plant shall be standard or dwarf; these items are for later consideration.

Theoretically at least one of the parents must be a coarse-leaved sort, and if it is possible to have both of that type the matter of foliage is settled at the outset. The fruit of the coarse-leaved parent needs to be as near to the desired form as is possible—it should not be a flat and ribbed fruit.

The other parent must be selected for the desired fruit character in particular, and as size and shape (usually) in tomatoes are sympathetic instead of antagonistic una, those two qualities need to be such that when blended with those of the fruit of the other parent the desired end may be reached. For example, the breeding of a "cherry" with an "apple" is apt to bring a "plum" by selection and inbreeding, the "cherry" having a great power in reducing the size; that is, the cross will be far closer to the small than the large fruit. In the making of the coarse-leaved "plum" the qualities of foliage behave quite differently from those of the fruit; in other words, should the choice of parents be with one

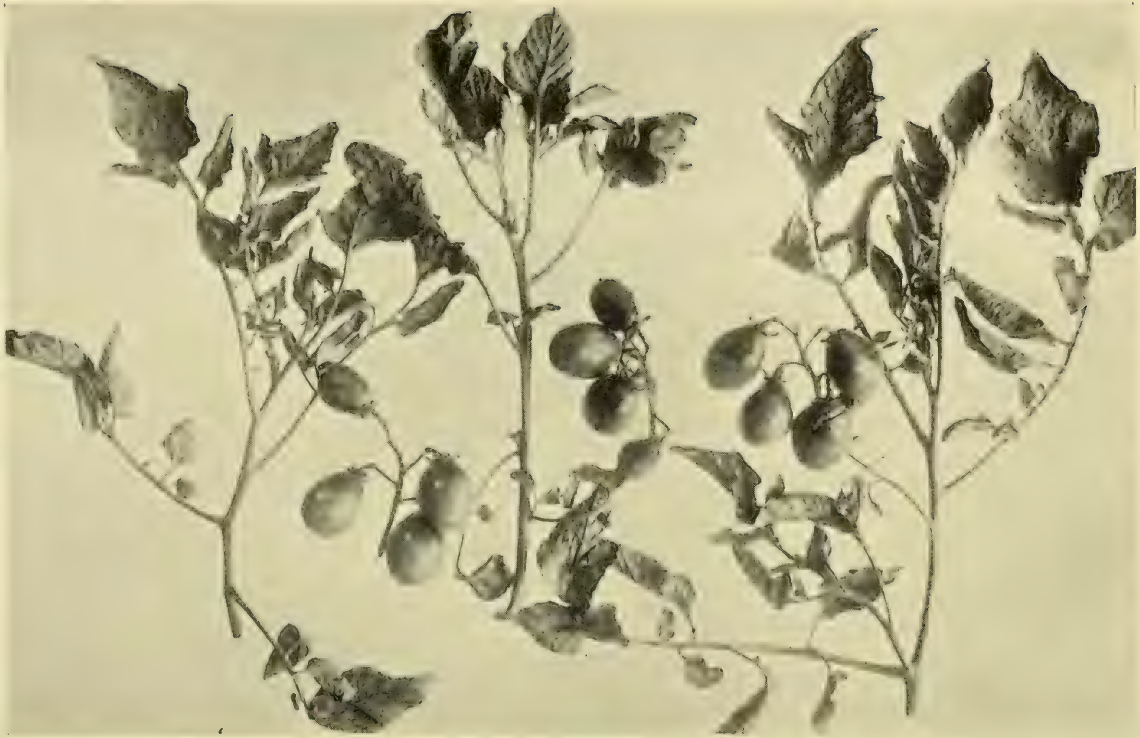


PLATE VIII.

Crossed Tomatoes—A coarse-leaved "Plum Tomato" getting its foliage type from "Magnus" and its size and form from a combination of "Sumatra Fig" with three kinds of the ordinary form.

having coarse foliage and the other fine, the coarse type will come out in the first generation after the blend (which blend should theoretically be standard) as one-quarter of all the plants, and when bred by themselves ever after remain as a pure coarse-leaved sort. The coarse and fine-leaved una, so to say, are antagonistic and the fine dominates over the coarse with no intermediates when the Mendelian rule is maintained.

As a matter of fact, Plate VIII. shows the result of breeding together of four commercial varieties as follows: In 1905 the "Magnus" (75) a coarse-leaved standard variety, with firm apple-shaped fruits, was bred to a cross of "Magnus" upon "Crimson-Cushion" (26), giving a mixture of coarse and fine-leaved plants. Coarse-leaved plants from this derivative cross were grown in 1906, and at the same time plants of a cross of "Ponderosa" upon "Sumatra Fig" (103/181). This latter cross gave plants that bore long apple-shaped fruits, and a plant selected for its length was bred in 1907 upon the "Magnus-Magnus Crimson Cushion" (75//75/26) cross above mentioned. One result of this compound cross was a coarse-leaved plant with "plum" fruits. By breeding this plant within itself, seeds were obtained that furnished a set of six plants, the present year, that agreed quite closely in respect to the foliage and fruit. Plate VIII. shows three sprays from as many plants with clusters of the fruits. The photograph was necessarily taken very late in the season, and the plants past their best condition.

It may be noted that the foliage is not as coarse as that of the average "Magnus" plant, but readily belongs to that type. The fruits likewise show some signs of the neck of the "Sumatra Fig." The peculiarities of the "Ponderosa" and the "Crimson Cushion" are not in evidence, and it is possible that the plum-shaped fruit and coarse foliage might have been reached by a more simple combination of the "Magnus" and "Sumatra Fig."

THE "JERSEY ORANGE" TOMATO.

The cross "Station Yellow-Magnus" (210/75) was bred last year upon "Station Yellow-Dwarf Stone" (210/169) and the blend plants were grown the present season, producing a remarkably noticeable row of plants bearing fruits of a rich orange color, quite unusual among tomatoes. The plants while in the standard group all showed a degree of dwarfness that suggested the lack of entire dominance of the "Magnus" type. An analysis of the compound cross shows that a standard plant selected from the first-named cross was bred necessarily to a dwarf, as both "Station Yellow" and "Stone" are dwarfs, and there is unusual opportunity for the infusion of the dwarf unun, should it be at all sympathetic, and this opportunity is increased by the plants in question being in the blend stage.

From the commercial standpoint the cross is a novelty of much promise, because the fruits come of sufficient size, apple-shaped, and with a fine rich golden flesh.

Another row of six plants showed the same novel color and agreed very closely in all respects to the set just mentioned. The breeding here was as follows: 210/169///140//170/144; that is, the "Station Yellow" was bred upon "Dwarf Stone" as in the previous series; "Stone" was crossed upon "Golden Queen" (170/144) and the "Waldorf" was united with the last cross, and finally the "Station Yellow"-"Dwarf Stone" worked upon the combination. As to colors, yellow was used twice, red twice and pink once, and the result is a rich orange that renders the fine large fruits particularly attractive. During the further testing of this cross it may well bear the name of "Jersey Orange."

A STANDARD COARSE-LEAVED YELLOW-FRUITED TOMATO.

The making of the above novelty illustrates a result that follows swiftly along Mendelian lines. Some years ago the "Station Yellow" was bred upon the "Magnus." This cross gave standard fine-leaved pink-fruited plants in the blend, but in the next generation there were eight sets of plants, namely:

Standard fine-leaved, pink	27
" " yellow	9
" coarse-leaved, pink	9
" " yellow	3
Dwarf fine-leaved, pink	9
" " yellow	3
" coarse-leaved, pink	3
" " yellow	1
	64

Assuming that these una bred according to the Mendelian rule, the number of plants for each combination in a total of sixty-four is appended. At that time no standard coarse-leaved yellow-fruited variety could be found in the market and the work of isolation was begun. According to the law governing dominance the yellow color of fruit and coarseness of foliage was at once separated by chosing a standard coarse-leaved yellow-fruited plant. It was necessary to eliminate the dwarf lurking in some of the standard plants, and this was accomplished by breeding several such to themselves and repeating this in the next generation, when a set of seedlings was obtained that contained no dwarf and the end was reached.

PALE FOLIAGE IN TOMATOES.

A very few commercial varieties of tomatoes such as the "Princess" and "Dandy Dwarf" have a pale foliage, suggesting that the plants are sick. Such plants seem in fact as vigorous as those with the usual dark green color, and in some instances they have exceeded in vitality the normal plants among which they stood. In breeding, this lack of green has acted as a unum in connection with the ordinary color—thus the "Yellow Prince" (148) has been crossed upon "Princess" (109), and the pale foliage plants came to light in the first generation and in numbers that suggests that it is recessive. This view is corroborated by the pale plants when bred within their own peculiar type always reproducing the pale plants.

The above peculiarity is one that does not show itself until the plants are of considerable size, and therefore prohibits their being discarded as seedlings at the time of transplanting to the open.

It might be possible as a matter of technical breeding to produce as many kinds of tomatoes with pale foliage as with ordinary green leaves, but, possibly, other than as curiosities the labor would not be well expended.

NOTES UPON HAIRINESS OF STEM.

The "Currant" tomato differs quite strongly from the ordinary sorts in the comparative absence of the long pointed hairs so objectionable in the latter. From the hybrid "Currant" and "Dwarf

Champion" (177/54), which has been kept in the breeding grounds for some years, plants were grown the present year that had much of the dwarfness of the "Champion" with the smoothness of the "Currant." Such plants are low, spreading with short leaves brought close together and the fruits borne in short racemes, and of the size of small cherries. Economically such plants are nearly worthless and are only retained for purposes of breeding.

During the present season four crosses with the above type of hybrid (177/54) have been grown, namely: (1) "Yellow Prince" (148); (2) "Humbert-Ponderosa" (64/103); (3) "Red Cherry" (176), and (4) "Yellow Cherry" (183), in all thirty-eight plants, of which eighteen were smooth, eleven hairy, nine intermediate.

Experiments with Peppers.

The peppers occupied Series I. of the home grounds and embraced fully 500 plants. The experiments were in the immediate charge of Mr. Shore, who did not live to carry on the work beyond the setting of the plants in the open. Very little breeding was done, and the following record is incomplete.

PEPPERS IN THE BLEND GENERATION.

Sixty-four blend crosses were grown in the gardens during the past season. Space would not permit of more than three plants of each cross, as each specimen was given sixteen square feet that it might not be crowded, and admit of easy observation from all sides. There were some accidents, and in some instances only one or two plants reached maturity.

The season was so unfavorable that probably all the plants were undersized, but as a whole they were abundantly fruitful. Less satisfactory results obtained with the parents, which in the attempt to grow the plants from year-old seed, and thereby introduce no confusing elements due to possible variation in commercial seed, failure resulted in some instances so that it was not possible to get a record in all cases of both blend and parent plants. While no counts were made or weights taken it was evident at a glance that the blend plants far surpassed the commercial sorts in output of fruit.

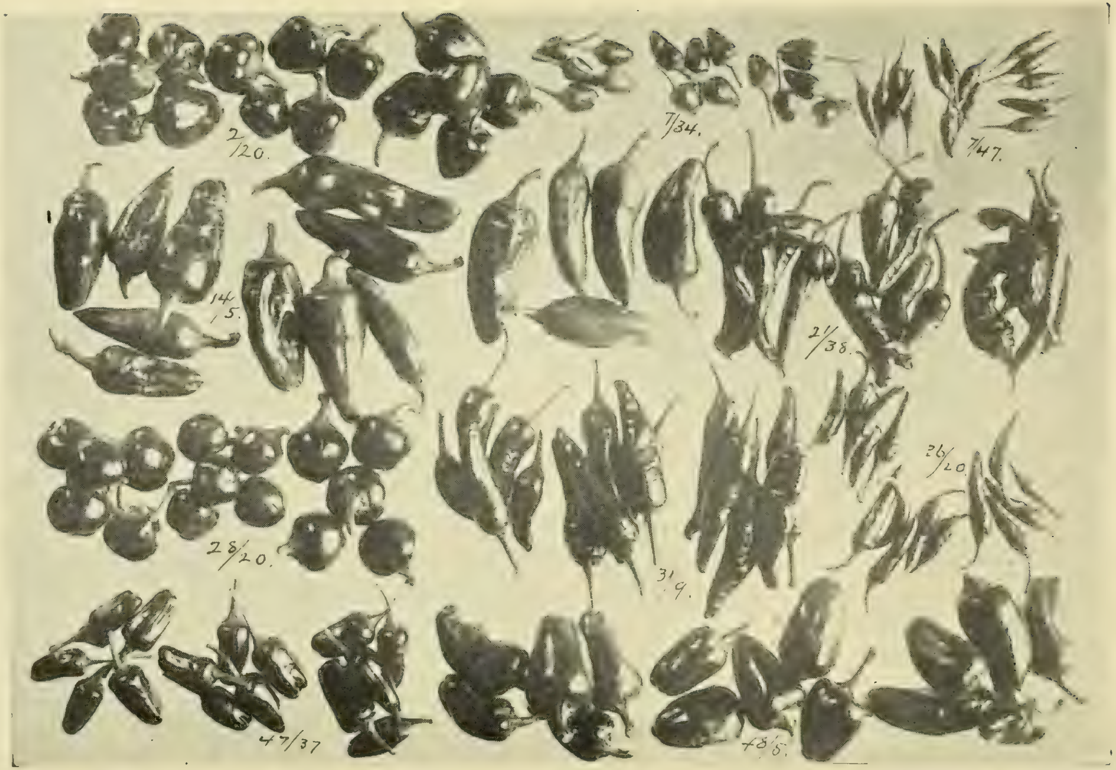

2/20.
7/34.
7/47.
14/5.
21/38.
28/20.
31/9.
26/20.
47/37
48/5.

PLATE IX.

Crossed Peppers—To show uniformity in the blend, ten sets of five fruits from each of three plants are given.

One of the striking features of this plot of blend peppers was the uniformity of the plants in the same cross; there might be a variation in size of plant due to local conditions, but as a rule the three plants of a set were all alike in the various characteristics of branching, foliage, flower and fruit. This is shown in Plate IX., where five mature fruits from each of the three plants of a given cross, gathered without seeking for any uniformity, are arranged side by side in three piles. The following are the ten crosses shown:

1. "Large Bull" upon "Red Cherry" (2/20); that is, a variety with a medium large flabby fruit with the tip deeply lobed ("bull nose" or "cat face"), is bred with a sort having a nearly spherical, small, smooth berry—the result is a fruit of double the contents of the "cherry" or without the flabby deep lobes of the "Large Bull." In point of yield of fruit flesh, this cross is doubtless far ahead of either perent.

2. "Celestial" upon "Giant Yellow King" (7/34) is a cross between two sorts that are nearly the same size, and the three piles show great uniformity. The parents were both upright fruited, and the cross is likewise.

3. "Celestial" upon "Tom Thumb" (7/47) is a cross between a high and a low plant, and in this regard the blend is a very uniform set of three low bushy plants. The pale yellow color of the "Celestial" fruits is lost from view beneath the red of the "Tom Thumb." The general shape of the fruits, ovate-lanceolate, and agreement in size of the two plants naturally brings uniformity in those characteristics in the blend fruits. Both parents have upright fruits and the same is true of the blend.

4. "Golden Dawn" upon "Black Nubian" (14/5). In this combination the male parent has medium large lobed orange, mild fruit, and the female with a long, oblong, smooth, dark purple-red fruit. The uniformity of the blend fruits is shown in the plate; they have all the length of the "Nubian" and somewhat of the breadth of the "Dawn," with a color that is a striking mixture of the two parents, in which the many fruits all agree.

5. "Red Cluster" upon "Glenmont Giant" (21/38). The male parent has a very long slender curved upright fruit, while the female is the opposite, namely, a broad, deeply-lobed, medium large pendant fruit. The blends, while quite uniform in general size and shape, vary greatly in the tip of the fruit, which in some is pointed like 21 and in others lobed somewhat as in 38. The fruits are pendant like the mother, but wrinkled like the male parent.

6. "Early Red Squash" upon "Red Cherry" (28/20). The 28 has a medium-sized apple-shaped fruit with a somewhat lobed tip, which with the "Cherry" yields a nearly uniform set of "Oxhearts," slightly angular in outline and varying most in the tip, which may be pointed or indented. In the middle pile the five fruits are somewhat smaller than these upon either side.

7. "Upright Sweet Salad" upon "Small Chile" (31/9). The 31 has a deeply-lobed short "apple" upright fruit, while 9 is quite the opposite, excepting that it is also upright. When both parents are upright the fruits of the blend take the same position; otherwise they are pendant in the blends. This set of three piles shows some variation in size of the fruits and in the tips, but the long parent has had much the greater influence in shaping the blend.

8. "Red Cranberry" upon "Red Cherry" (36/20). Both parents are small fruited, the 36 being very slender and long, and soon wrinkled upon reaching maturity. The "Cherry" has been mentioned in two previous crosses in the blend; while quite uniform, the fruits are nearly as long as 36 and as broad as the "Cherry." The bulk of the fruit has been increased.

9. "Tom Thumb" upon "Giant Yellow King" (47/37). This is a case of a low spreading plant with small ovate-lanceolate upright red fruits, being bred to one bearing medium large, deeply-lobed, apple-shaped yellow fruits. This blend is very attractive with its uniform red fruits, produced in great numbers; size much nearer 47 than 37, but all more or less angular and the tip sometimes pointed.

10. "New Tomato" upon "Black Nubian" (48/5). In 48 is a firm-fleshed, slightly angular apple-shaped upright fruit, that being bred with the "Nubian" gives a fairly uniform set of medium-sized fruits that represent the "Nubian" at the base and something of the lobation of the "Tomato" in the free end. In color the fruits are mottled indistinctly with red and black, so that some are a rich variable mahogany—an unusual blending in the blend.

A STUDY OF THE FIRST GENERATION FROM THE BLEND.

The breeding together of the "Long Red" (41) and the "Coral Gem" (11) combines an old standard sort of the long type of pendant fruit with a dwarf kind having a small upright fruit. There

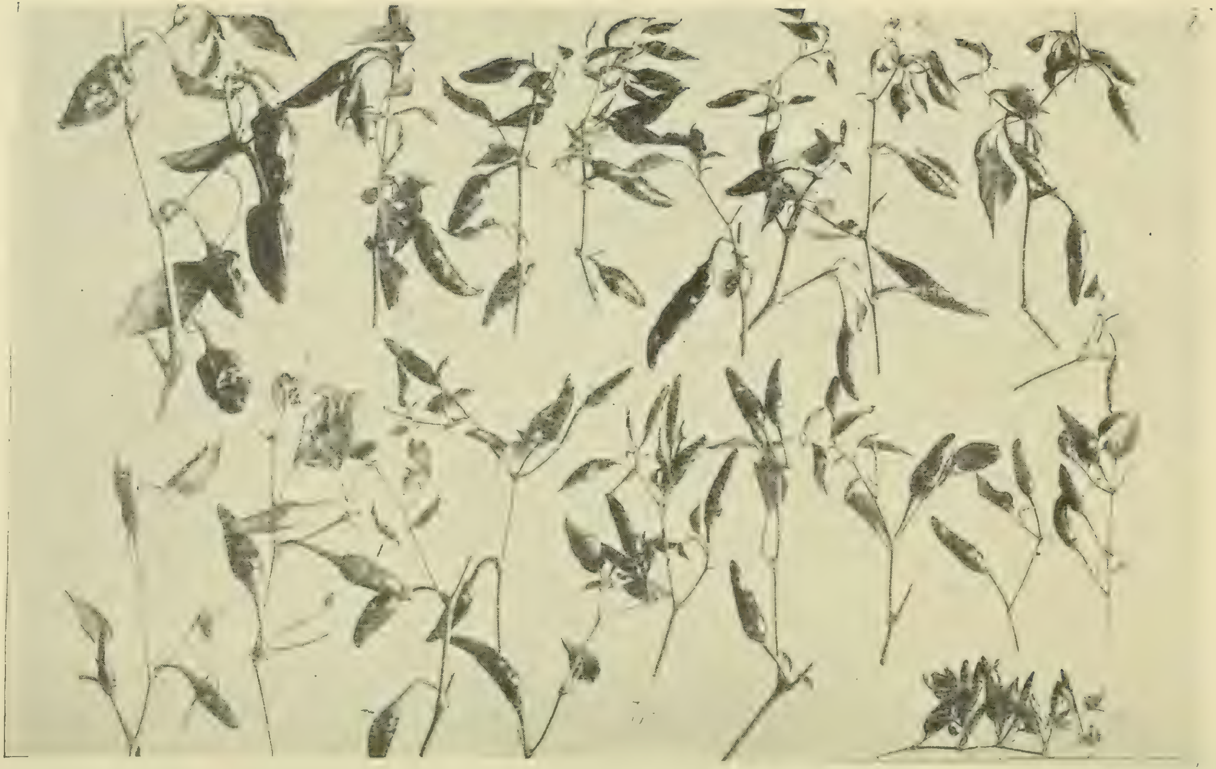


PLATE X.

Crossed Peppers—The male parent "Long Red" (41) is shown at upper left hand corner, and the mother "Coral Gem" (11) at the opposite corner with a series of sprays, one from each first-generation plant between.

were seventeen plants in this group, samples of which are shown in Plate X., with the male parent ("Long Red") shown in the upper left-hand corner, and the mother ("Coral Gem") at the lower right-hand corner.

The plants were, as a rule, wide-stemmed and several broke down early in the season. There were four full standard plants: four prostrate upon the ground, as is the habit of the mother (11); six partially prostrate (which accounts in some measure for the breaking down above mentioned) and three flat-topped, bushy, semi-standard plants. The foliage was very variable, one as coarse as 41, two nearly as fine as 11—the whole lot would be classed among the fine-leaved sorts and therefore shows that the "Coral Gem" had a quite decided power in controlling the type of leaves. A study of the length of internodes in the individual sprays in the plate will help to give an idea of the size of the plants, but, of course, does not help much to a knowledge of the form of the whole plant. When each branch is studied as to its fruits it is seen that there is a range in size and shape that points to the conclusion that, in this case, at least these characteristics do not conform to any Mendelian rule. While there are no cross fruits as large as the "Long Red" or small as the "Coral Gem," it is true that they could be arranged in a series with one end approaching the larger parent and the other the smaller. The same is true of the shape, for some are fuseform, smooth and nearly straight like the "Coral Gem," while others are curved and rugose like "Long Red."

The position of the fruit, whether pendant as in 41 or upright in 11, is very puzzling in this cross, because of the long weak stems and, therefore, their soon bending downward. A fruit that when half grown is upright may bend in some instances upon certain plants and be pendant when fully ripe; an attempt has been made to arrange the sprays so that pendants as a whole would be near the pendant parent and the upright in the lower half of the picture. The last are five unmistakably upright and the same number pendant, leaving seven that are more or less pendant; there are other crosses between the upright and pendant groups that show the Mendalization more clearly, perhaps due to lack of confusion arising from the early bending of the whole branches.

The "Black Nubian" (5) is a well marked variety, from its purple flowers, almost black, long, broad, tapering fruit when green, becoming orange-red at maturity, while the "Golden Queen"

(15) has the fruit larger, deeply furrowed and lobed, and yellow when ripe. A set of twenty-six fruits from as many plants, taken without any attempt to select for any type, is shown in Plate XI. The set of cross fruits was arranged in a series, placing those that favored the "Nubian" form near a sample of that variety (1,) and those resembling the female parent nearest the "Golden Queen" sample shown at 2. All the set show somewhat of the lobation of the "Queen," while at the same time even those most deeply grooved have the base of the fruit somewhat like the "Nubian."

The color of these above twenty-six fruits, after leaving open the table for study for some weeks, showed a range from nearly black to clear unmarked orange, which included four, representing all ranges of size and form, while five were nearly pure black, the other seventeen being a remarkably mixed lot of fruits, with stripes and blotches of black, brown, red, orange and yellow.

The subject of pungency is not an easy one to investigate, for, until some chemical or other test aside from the tongue is employed, the accuracy of the results will be called in question unless reported in very general terms; for example, if the experimenter tastes of a hot piece of flesh at the outset he is unfitted for further testing for a long time. In the present instance, so far as a limited amount of testing will justify, the opinion is that pungency is widely different among the twenty-six plants, and seems to be much less as a rule than in the "Nubian"—the "peppery" character is probably modified by the "Queen," which is a mild or "Sweet" sort.

The "Coral Gem" (11) is a variety with prostrate spreading plants of the small-leaved and small-fruited type, which in this instance is the male upon the "Red Cluster" (21), a distinct kind because of the compact habit of leaf and fruit formation. The two plants are shown as 1 and 23 in Plate XII.; and it is observed first of all, perhaps, that the single sample from each of twenty-one plants, making up the set of this cross, have fruits all upright as might be expected, for the parents agree in this. It is also shown that the size and shape are quite uniform and near that of the mother plant; this is, however, true that instead of the curved and rugose fruits of the "Red Cluster" they are broader (spindle shape) and more nearly straight, in this respect, showing strongly the influence of the "Coral Gem." The failure of the last named

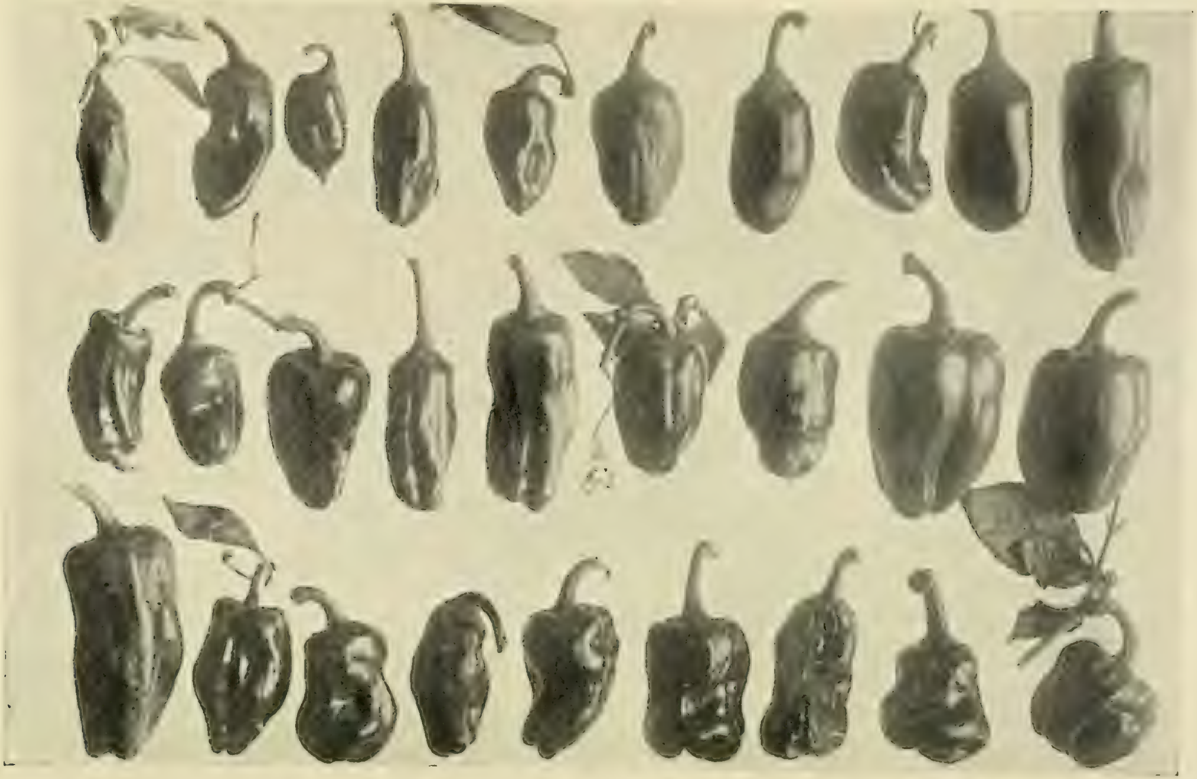


PLATE XI.

Crossed Peppers.—A fruit of the male parent "Black Nubian" (5) is shown at upper left hand corner and of the mother "Golden Queen" (15) at the opposite corner with a series of fruits, one from each first-generation plant between.

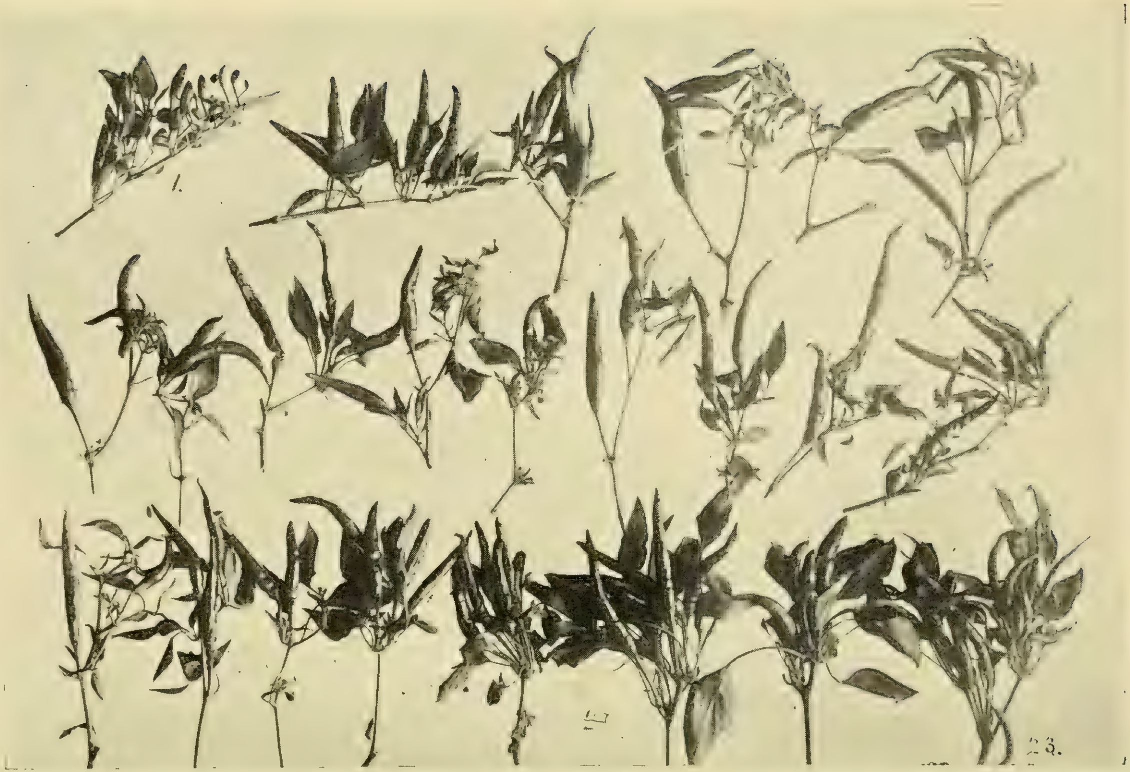


PLATE XII.

Crossed Peppers—A spray of the male parent "Coral Gem" (11) is shown at the upper left hand corner and of the mother "Red Cluster" (21) at the opposite corner with a series of sprays. one from each first-generation plant between.

to reduce the size of the fruits of the cross is not accounted for, however, and is contrary to the general rule with allied plants as the tomato and eggplant.

There is a marked difference in the type of foliage in the set, for at least seven, with the clustered form of leaves, show this fully as in the mother parent as evidenced by the specimens placed directly to the left of the "Red Cluster" in the engraving.

The following tabular form expresses some of the results:

Prostrate plants 8.....	Compact foliage, 3.
	Scattered foliage, 5.
Bushy—15 inches high..	Compact foliage, 3.
	Scattered foliage, 5.
Bushy—24 inches high..	Compact foliage, 1.
	Scattered foliage, 2.

Total compact foliage, 7; scattered foliage, 12.

As a matter of record there were eleven plants with red fruits; six with orange, and four that were intermediate in color; that is, orange-red. The appearance of the straight orange in such large numbers is not accounted for, excepting that the mother plants often show a strong mixture of orange in the over-ripe fruits.

While there is grave doubt as to the accuracy of the name of "Cranberry," as associated upon the seedsman's packet, with the seeds used for the male parent of the above cross, the group of offspring is given nevertheless. Doubly unfortunate, no seeds of the original packet grew this season, and a study of this questionable parent has been forestalled. It has behaved as the "Red Cluster" might be expected to do in combination with the "Red Cherry."

The "Red Cherry" (20) is a late, widely-branching plant, with a round, smooth dark red pendant fruit, an inch in diameter, and firm of flesh. A sample spray is shown in the lower right-hand corner of Plate XIII. The "Cranberry" (36) on the other hand, as recorded for last year, was a dwarf with the long slender upright fruits borne among the clusters of long leaves. A dwarf plant that most nearly resembled this parent is represented in the first spray in the picture. The shapes of the fruit here fall generally into two groups: (1) the round and (2) the slender; of the former, there being four and the latter twelve with four intermediate. In other words, one with the Mendelian law in mind might note that it possibly has been active here in regard to the shape of the fruits; as to the position of the fruits upon the stem, four are upright and sixteen not; that is, fully pendant or partially so. It is possible that among these last sixteen, four might be counted as pendant, and eight that are intermediate. The upper portion of the plate is occupied with sprays that show the leaf cluster, more or less.

A STUDY OF POSITION OF THE FRUITS.

Below is given a summary of the position of the fruits in the first generation after the blend:

No.	*Cross.*	*Pendant.*	*Upright.*	*Intermediate.*
1	1/36 I	13	6	6
2	5/9 I	16		
3	5/15 I	31		
4	10/51 I	4		
5	11/21 I		20	
6	17/9 I		45	
7	25/11 I	4		
8	26/21 I	12	9	
9	28/11 I	8	5	7
10	28/20 I	17		
11	31/9 I		4	
12	36/20 I	17	4	
13	38/11 I	12		
14	41/11 I	3	4	12
15	42/9 I	8	4	
16	42/26 I	2		
17	48/36 I	9		

In all cases where both parents were with pendant fruits, the cross showed only the same position, and in like manner varieties with upright fruits when bred together gave only upright fruits.

Of the six instances where varieties with unlike position of fruit were crossed, the total result is as follows: Pendant, 61; upright, 32; intermediate, 25. If the last are counted with the pendants the uprights come within easy range of the theoretical number (29.5) in the application of the Mendelian rule for recessiveness in the upright position.

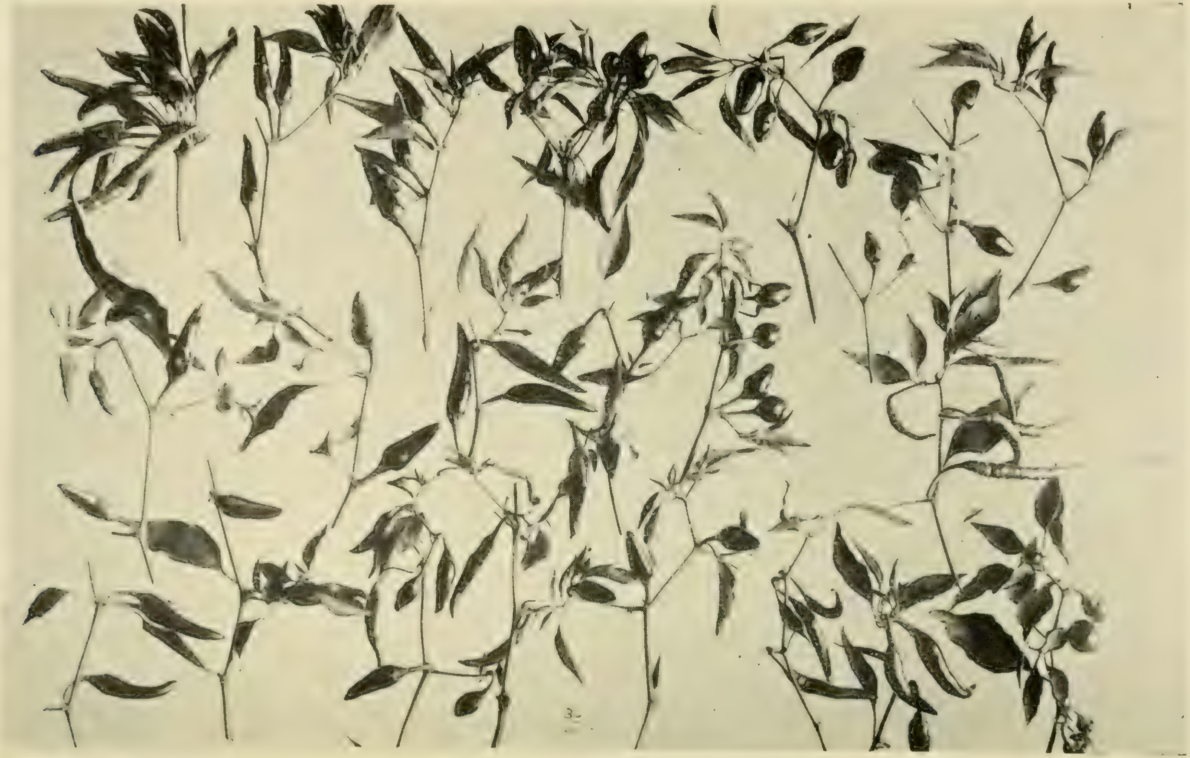
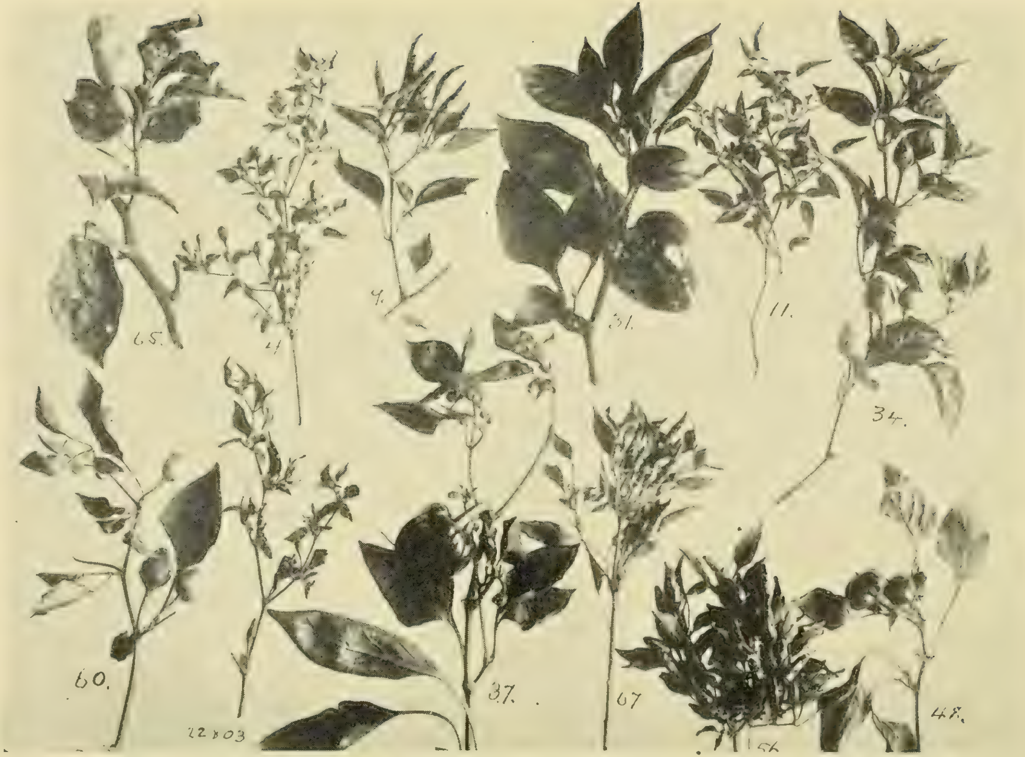


PLATE XIII.

Crossed Peppers—A spray of the male parent "Cranberry" (36) is shown at the upper left hand corner and of the mother "Red Cherry" (20) at the opposite corner with a series of sprays, one from each first-generation plant between.


65.
4
9.
31.
11.
34.
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22803
37.
67
56
48.

PLATE XIV.

Peppers—Contrasting types of foliage in their arrangement upon the stem and general outline.

RANGE OF LEAF FORMS IN PEPPERS.

As with many other kinds of plants there is, with peppers, considerable range of sizes and shapes in the leaves upon the same plant—dependent upon location upon the stem and the many conditions of light, moisture, food-supply, &c.; there are, however, among the varieties a number of types of more or less definiteness. For example, a strong contrast is seen between the foliage of 65 ("Ruby Pearl") and 4 ("Bird's Eye"), sprays of which are shown side by side in Plate XIV. A careful study of the foliage, however, confirms the belief that the evident difference is chiefly one of size. In the next pair, 9 ("Small Chile") and 31 ("Upright Sweet Salad"), while the most evident difference is size—as judged from the picture these leaves have much longer petioles than in the first pair. A medium large leaf with long petiole is shown at 60 ("Kaleidescope") in striking contrast with a sort this year received from Washington, D. C., without name (No. 22803, U. S. D. A.). A very long form of leaf is shown at 37 ("Giant Yellow King"), while at 67 ("Japanese Chile") and 56 ("Yellow Chile") are seen two types of plants—the low and the dwarf, respectively, showing the lanceolate leaves with very large petioles produced in quite dense clusters and mingled with the fruit, and giving reason for this form being placed in a separate species.*

It might seem almost a matter of necessity that the petioles should be long in the form in question, and it remains to be noted what effect upon this character has the breeding of such plants with others, of the more ordinary sort, like 11 ("Coral Gem") and 34 ("Christmas"), or the 48 ("New Tomato") with the long internodes and, therefore, widely separated leaves.

SEEDLESS FRUITS.

The small sorts of peppers, either of the lance or spherical types, are, as a rule, packed with seeds, but with the large inflated sorts, having the sides ridged and free, the end deeply lobed ("bullnose"), the seeds make up but a comparatively small portion of the whole fruit. It is among the latter only that seedless specimens have been found, as grown in the open; they can probably be obtained among any kind by the exclusion of pollen, and Plate XV. shows several of these in sectional view. Four samples with seeds are given in the upper left-hand corner for sake of contrast with those that are seedless and also to illustrate the placentation in the normal fruits. The sample at (1) shows five cavities, a rare occurrence, as four usually is the highest number. At (2) the four cavities as individuals are shown, and in two of them secondary pistils may be seen, one of considerable size. A glance through the groups of fruit will reveal the fact that several other seedless fruits have these abnormalities in greater or less numbers—sitting like little birds in a nest with their necks (styles) rising in midair.

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*Capsicum fasciculatum by Sturtevant, Bull. Torrey Bot. Club, 15–133–1888.

The reason for the seedlessness is not apparent, and no study of the subject has as yet been made, the intention here being to record the fact and that the carpellary walls inclosing the barren placentæ may enlarge to normal size and shape. Frequently, however, the seedless peppers are much bent and twisted and seeds are found only upon the side of greater elongation.

SECONDARY PISTILS IN PEPPERS.

Associated quite closely with the larger and deeply ribbed and lobed fruits is the formation of secondary pistils, as previously mentioned. It is not very unusual in such to find associated with the seeds a comparatively large, irregular growth consisting of a coat of flesh, and a cavity within that bears some resemblance to the same portion of the primary fruit of which this abnormal growth forms a part. Plate XVI. shows a number of the fruits in question. At 1 all the parts of the fruit have been removed that the internal pistil, shaped almost like a leaf and green in color, may be shown as it grew at the base of the placental column. A similar structure is in 2, but not so evident, as it lies upon the left side of the seed-bearing column. At 3 the internal pistils appear as small, nearly round pouches, while at 4 one is shown at the upper side extending out like a sickle. At 5 in tranverse section, several small pistils are shown in a group as they were found at the upper end of the placentæ; those at 6 are quite evident and have somewhat the form of the mother pepper that bore them. At

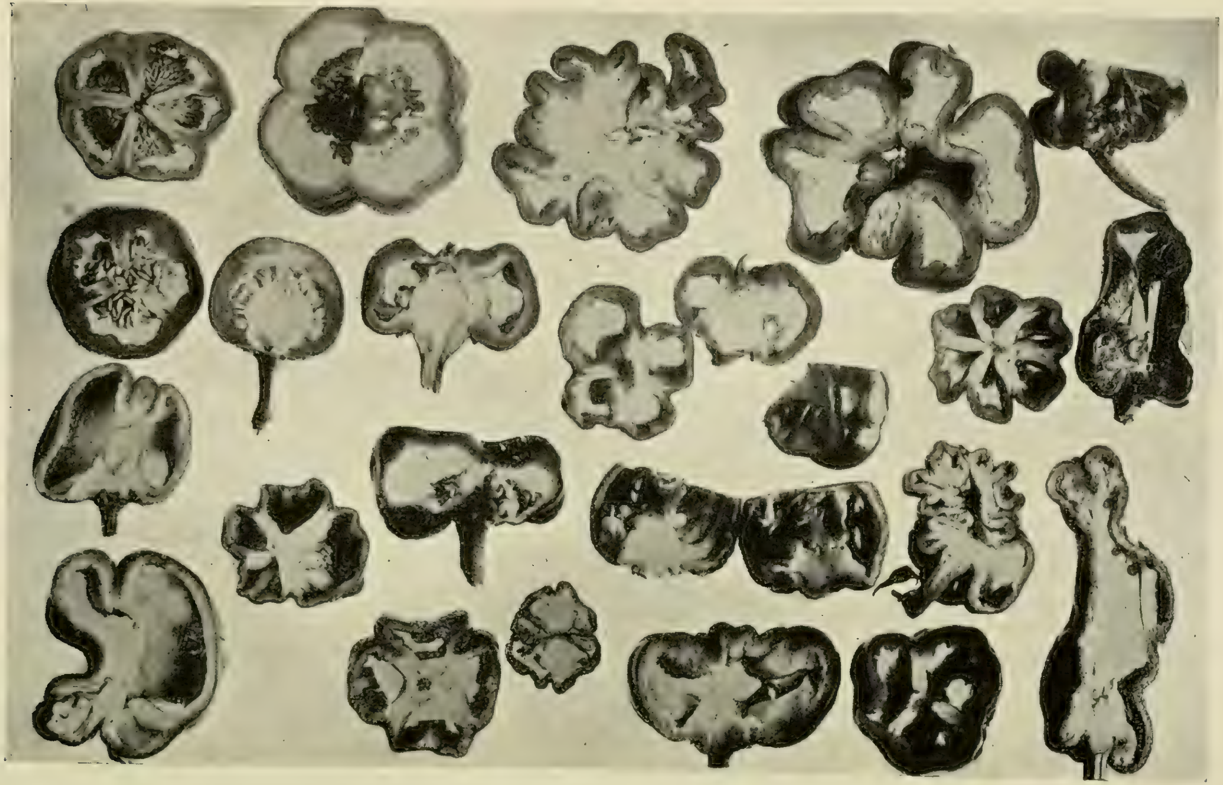
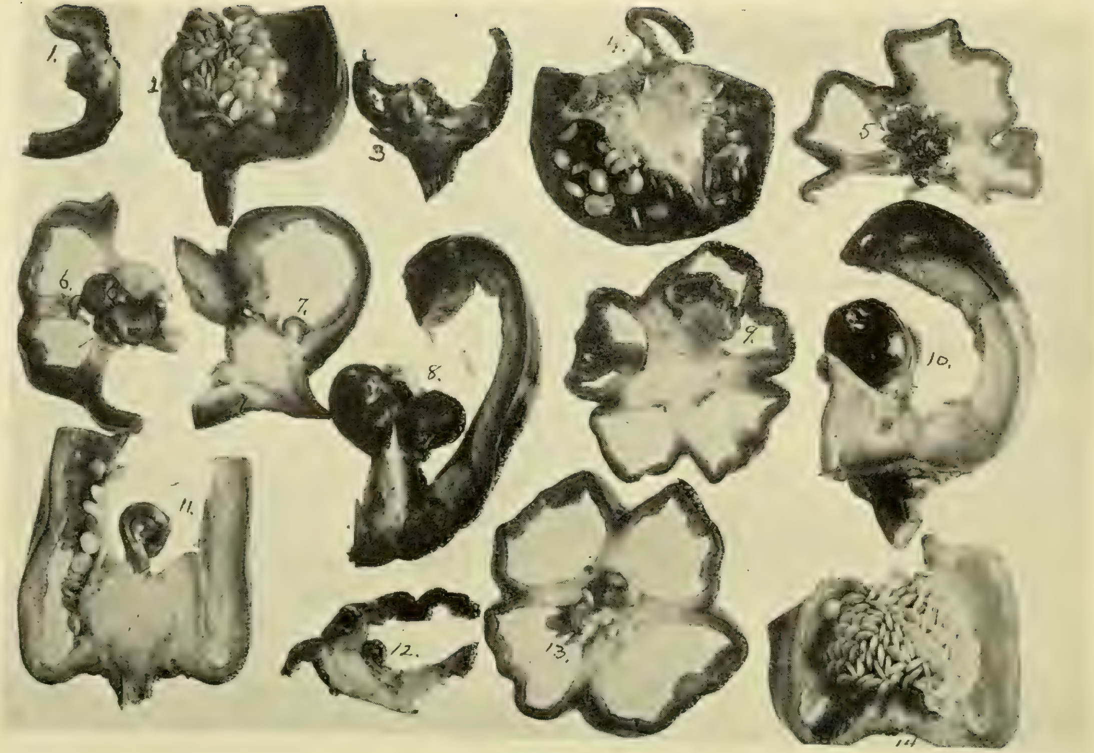


PLATE XV.

Peppers—With the exception of four in the upper left-hand corner the fruits, while as large as ordinary, are usually seedless.


1.
2
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14

PLATE XVI.

Peppers—Sections of fruits are shown in which pistils may be seen associated with the seeds or upon the wall usually bearing seed.

7, in a seedless fruit, a small pistil is shown in sectional view, while at 8 in a longitudinal view two pistils of considerable size are shown near the center of the column that usually bears seeds. A similar structure is shown at 9, in which the cavity is well defined; at 10, within a seedless fruit center is occupied by two secondary pistils, one of which is as large and well formed as a sample of the "Cherry" variety. At 11 a long and greatly bent form is shown at the head of the core of the fruit, while some of the seeds are present, thus giving the relative size of the secondary fruit. Other illustrations of the monstrosities are shown at 12, 13 and 14 in different views and associated with the normal occupants of the center of a pepper pod.

Experiments with Ornamental Plants.

The front border of the home grounds is occupied with ornamental plants, and among them some breeding work has been done from year to year.

BREEDING OF PINKS AND CARNATIONS.

At 1 in Plate XVII. is shown a spray of *Dianthus Chinensis* var. *laciniatus* Reg., and is the male parent of the form shown at 2, as obtained by breeding upon the commercial variety "Purity," specimens of which are given at 3. The male is marked by its long, broad and deeply fringed petals and narrow dark green leaves, both of which characters are shown in the blend (2), while "Purity" has contributed its tendency to doubling. The white flowers of the mother are approached in the blend where the corollas are sometimes only slightly splashed with pink.

At 4 is shown a combination of "Purity" upon the common "Sweet William" (*Dianthus barbatus* L.), the plants being dwarfs thus favoring "Purity," and like it also in blooming in early autumn from seeds sown the same season. Both parents have broad leaves and double flowers in close clusters, but the individual blooms in the blend did not average more than a quarter the size of "Purity." The flowers varied from dark to light red, sometimes variegated, but none were white.

The sprays shown at 5 represent blend plants from the breeding of *D. barbatus* upon *D. Chinensis* var. *laciniatus.* The foliage is midway between the two parents, while the flower clusters and rich color of the petals are like the male parent. On the other hand, the large blooms and fringed petals show the influence of the mother.

A hybrid blend plant is represented at 6 of *D. barbatus* upon *D. latifolius.* Both parents are hardy perennials, the male being the well-known "Sweet William," and the mother is shown at 8. The combination produced plants of great vigor, blooming freely with the handsome flowers of good size, borne in small clusters upon long erect slender stems, a decided improvement upon the male parent. The blooms, uniformly of a rich deep pink, had a pleasing fragrance, but were entirely free from stamens.

The cluster at 7 represents a hybrid between the carnation (*D. Caryophyllus* L.) and *D. latifolius,* which has been grown for two years and propagated freely by cuttings, as the hybrid produces no pollen. Plants will be left in the open during the coming winter to test their hardiness.

HYBRID PHLOX.

A union of "Perennial Blue Phlox" (*Phlox divaricata* L.) upon a red variety of *Phlox Drummondii* Hook was secured in 1907, but the blends failed to produce seed. A similar hybrid between perennial and annual plants was obtained in 1908, when the above-named blue was worked upon the "White Star," and two plants of the blend were grown in the greenhouse. Plant 1 began blooming in January (1909), and having flowers slightly "starred" and reddish-purple in color. Plant 2 bloomed a month later and also bore "star" flowers somewhat larger than those of plant 1, and in color were a shade of blue, bordering upon lilac. In May both plants were placed in the open together with two cuttings from plant 1, where they continued to bloom until midsummer. Repeated efforts to (1) fertilize with each plant's own pollen, produced in abundance; (2) breed plants 1 and 2 together, and (3) unite again with either parent, failed, and, therefore, no seed was obtained. The plants died in August, fifteen months after the seeds were started.

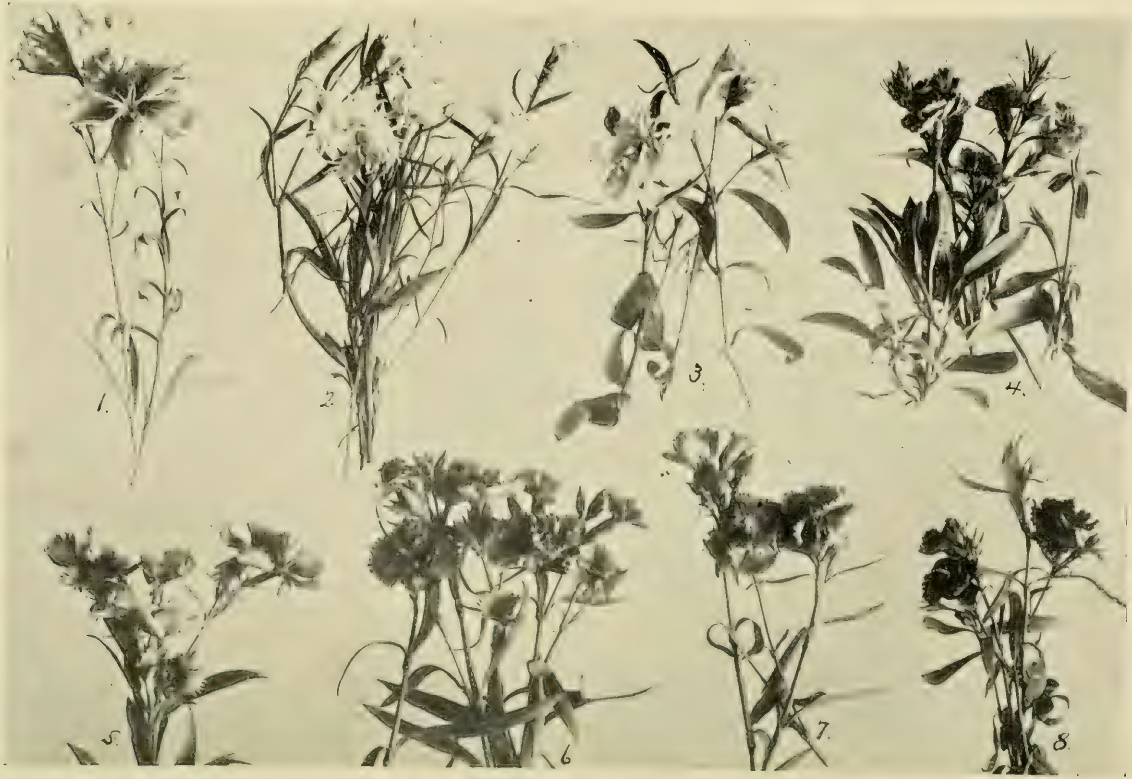

PLATE XVII.

Carnation-Pink Hybrids—The results of breeding various species and varieties of "Dianthus" are shown.

HYBRID FOXGLOVE.

The hybrid plants of *Digitalis purpurea* L. upon *D. lanata* Ehrh. produced flower stems from four to six feet high, branching much and forming an unusual type of border plant. Hundreds of the purple-tinged creamy flowers were open at the same time and constantly visited by insects, but no seeds were produced. The capsules would swell hopefully for some days and then become wrinkled. Many attempts were made to get seed by hand pollination without success, even when it came from the small-flowered parent *D. lanata*.

There was some range of size and markings of the flowers among the plants, in fact no two were entirely alike. It was also noted that certain of the flowers were much larger than the ordinary upon the plant, reminding one of the monstrous blooms that are often met with in the purple foxglove, particularly at the end of the flower stem. But in this case they were among their fellows along the axis of the plant.

HYBRID NICOTIANA.

A number of first generation plants of the hybrid *"Nicotiana Sandriá-N. alata"* were grown this season. Some had the pure white flowers of *N. alata*, while others showed strong coloring upon the outer surface of the corolla. The decided odor of *N. alata* was not in any of the hybrids, a faint perfume only being detected. No plant had flowers as small as those of *N. "Sandrea,"* nor was its rich color inherited, but instead unattractive, subdued derivatives prevailed. One plant had a tendency to produce variegated foliage in the greenhouse, but when taken to the gardens it became normal. On the whole, the plants this season were not as showy as their immediate ancestors last year—partly due to the dry weather, but in some measure because of the "dirty" shades of color that came out in the first generation.

THE "GOLDEN BOWL"-"OKRA" HYBRID.

During the present year a blend hybrid has been grown of two species of Hibiscus, namely, *H. Manihot* L. upon *H. esculentus* L. This union was secured last year after many attempts and it is quite evident that the two species, seemingly of close kinship, do not breed freely.

The male parent (*H. Manihot*) it a tall, somewhat whip-stemmed plant with large palmate leaves, having long narrow lobes. The flowers are large with golden-yellow petals suggesting one of the common names, "Sunset Hibiscus," and are followed by ovate capsules covered with fine, piercing, stiff hairs. Specimens of stem, leaf, flower and fruit are shown in the left third of Plate XVIII. Sample parts of the "Okra" are given in the right third of the same plate, when the broad maple-shaped leaves are given with the stout stems and two types of the fruit smooth and ridged. Specimen portions of the hybrid are shown between the two parents, and the reader may notice that in nearly all details there is a blending of the two species.

The hybrid grew vigorously and attained the height of ten feet, and much excelled the tallest specimens of either parent. Free blooming continued until cut short by the frosts, and a large number of pods were produced. The seeding capacity was, however, quite limited, a feature that in itself would suggest that the parents were of different species.

This creation is probably of no economic value as a culinary plant, as the pods partake of the dry woody nature of the Manihot and soon bear the disagreeable stiff hairs, although they are smaller than in the last-named parent. On account of its large size and strong blooming tendency it might become of value as an ornamental annual, when showy blooms are desired in beds and borders.

The plant produced forty-three mature pods. The three served with "Golden Bowl" pollen produced in all thirty seeds; the four receiving "Okra" pollen gave a total of thirty-seven seeds, and the one worked within the plant yielded no seeds. The thirty-five flowers left to themselves produced only twenty seeds; that is, many of them were entirely empty.

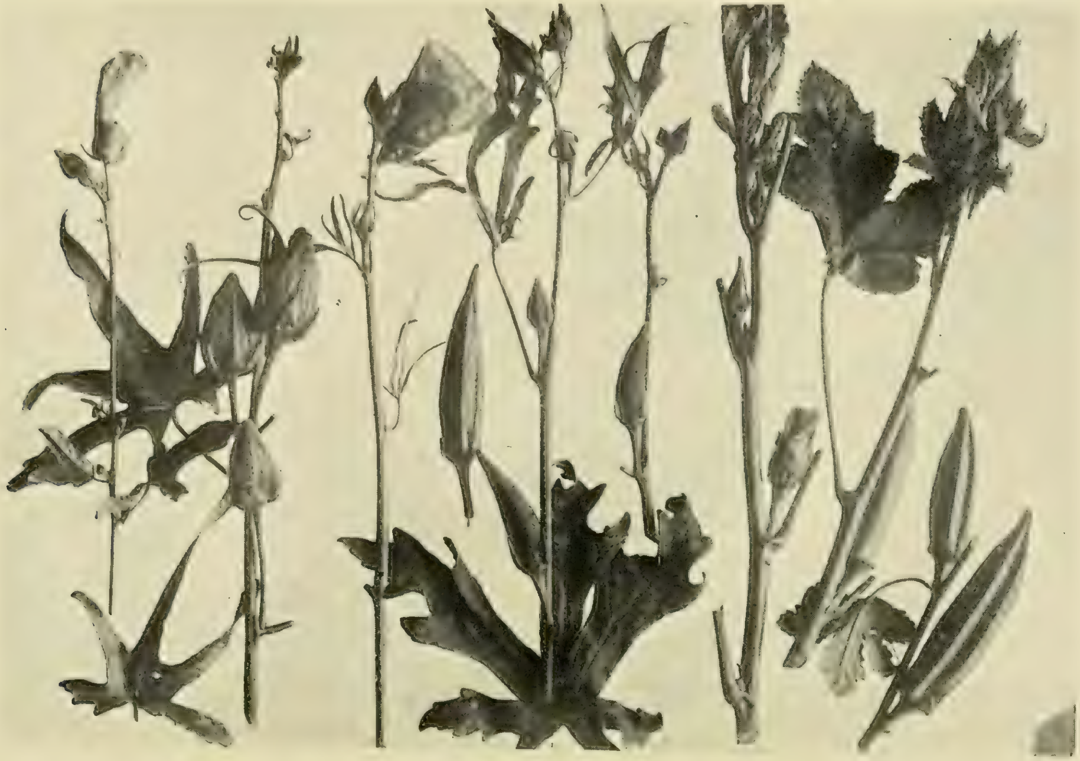

PLATE XVIII.

Golden Bowl-Okra Hybrid—Portions of the *Hibiscus Manihot* L. are shown in the left third, of the okra (*H. esculentus* L.) in the right with the hybrid situated between the parents.

PANSY CROSSES.

Selection of the Pansy-Violet strains of some years' standing—a union of *Viola tricolor* L. upon *Viola Tricolor* var. *arvensis* DC. have given very free blooming plants with the flowers, two-thirds the size of the ordinary pansy and plain bright yellow or marked with shades of blue. These hardy plants are among the first of the spring bloomers in the ornamental grounds, as well as the last to continue in flower in autumn, making them of value as bedding plants.

An attractive blend of "Papilio" and "Purple Queen" of the "horned violets" (*Viola cornuta* L.) has been grown this season. The crosses are in shape of flower like "Papilio" white in color; some approach one parent and some the other.

SNAPDRAGON CROSSES.

Some of the first generation plants of the cross of "Giant Red" upon "Dwarf White," reported upon somewhat fully last year, were transplanted to the ornamental grounds, but owing to the illness of the attendant the work of breeding within the plant was not carried out. As the plants showed quite a range of color combinations, a good opportunity seemed at hand for the attempt to fix strains by inbreeding.

ROSE CROSSES.

In 1908 a cross was secured of the "Crimson Rambler" upon "Baby Rambler" and seven blend plants were grown this season. The ordinary "Rambler" is so thoroughly introduced that all are more or less familiar with this conspicuous, profuse, late-blooming, rampant climber. The "Baby" is of quite recent origin and makes a low stiff-stemmed bush that bears abundant blooms in clusters and of the size of the Rambler, but of a somewhat darker and more pleasing red, and continues through the growing season. It is too soon to write of the blend more than that it as yet shows no signs of climbing.

PELARGONIUM (GERANIUM) CROSS.

A delicate rose-pink flowered "geranium" having single blooms in large heads, has been crossed with the dark red double flowered "Marquis Castellane." The blend is an unusually attractive plant in stem and leaf, with the single flowers a pure brilliant red, borne in a fine large ball.

THE WHITE STAR PHLOX.

The cross between the colored fringed (*"cuspidata"*) "Drummond Phlox" and the plain white (*"alba"*) form was so far developed that fifty-six packets of its seed were sent out for general testing. From the reports still coming in as this report goes to press, the following are given:

(1) "Grew finely; blossomed continuously until late." (2) "The flowers were white without exception. Plants strong; continuous bloom from the first. The starry character varied greatly; the petals sometimes so dwarfed as to be nothing but white rays." (3) "Fairly vigorous; blooming profusely with mostly star-shaped flowers." (4) "Flowers pure white—a distinct novelty; am well satisfied with it." (5) Blossomed freely; all except three plants had star-shaped flowers." (6) A very prolific bloomer; some of the flowers were like spiders; that is, long narrow petals and small centers; blooming regardless of the cold." (7) "Flowers rather small, but considerably admired because of unique shape." (8) "Fully 98 per cent. germinated. I observed three distinct forms; one very deeply notched, another six-pointed and third a plain kind. This phlox might take the place of 'Alyssum.' "

Several report that the plants were destroyed by the dry weather. One tester of the Phlox writes that in connection with it, "By mulching and irrigation, [I] laughed at the dry season."

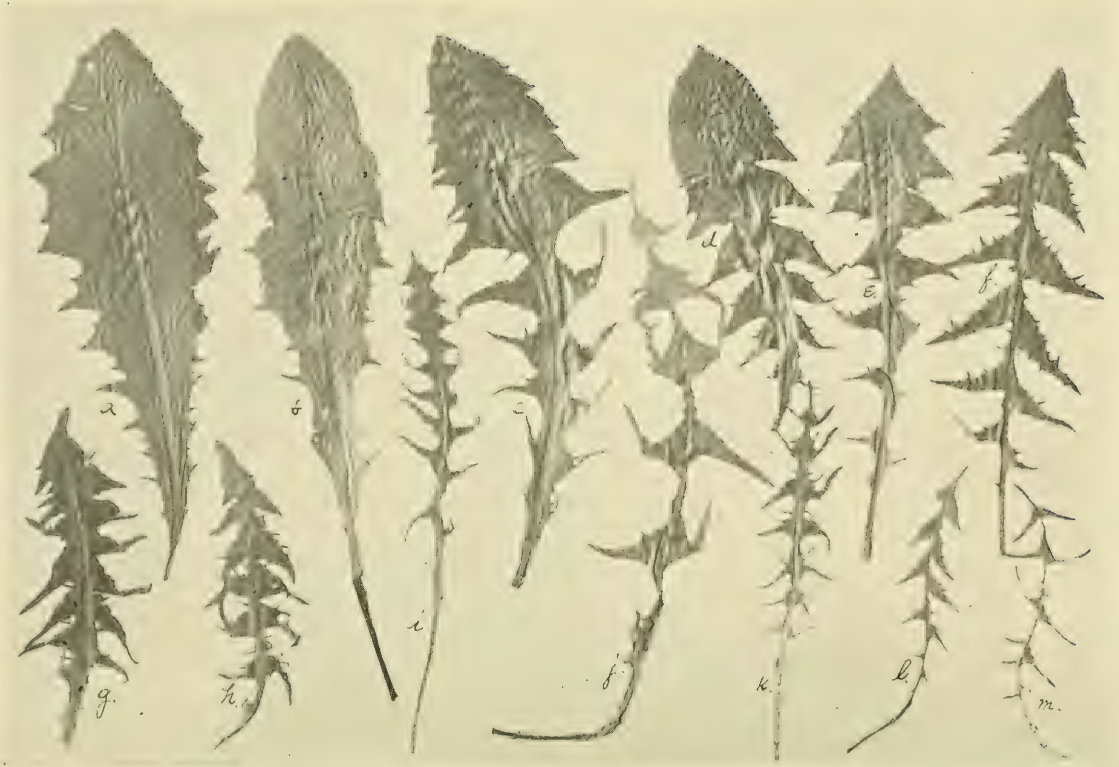
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PLATE XIX.

Variability in Wild Plants—A set of dandelion leaves as produced by thirteen plants under culture.

VARIATIONS IN WILD PLANTS.

A study of the question of variation in cultivated plants leads naturally to a consideration of this subject as illustrated in wild species. With the aid of a few plates and the accompanying text, something of the wide variability of our common weeds and other plants is herewith presented.

THE DANDELION (TARAXACUM TARAXACUM (L.)).

Always at hand is the dandelion, and thirteen of these plants found upon the border driveway to the breeding grounds were transplanted to good soil and given clean culture for a season, when sample leaves were gathered for the photograph from which Plate XIX. has been made. The leaves are arranged in a series from *a* to *m* and show great range in absolute size, in the amount of expansion and the manner in which the reduction of the surface is effected. The leaf *a* is, at first glance, like *b*, but a close study will show that one is much longer than the other—a difference that is quite constant with plants grown under the same conditions. Had the plant *a* been shaded, as by placing a truck barrel, with both heads removed, over it, its leaves would have become elongated and the resemblance to *b* much more complete.

It is further true that a close study of the dandelion shows that upon the same plant there is sometimes quite a range of forms; thus, it may be, in rare instances, as great as from *a* to *c* or *d*, which suggests that location upon the stem, age of leaf, food and sun supply, &c., need to be considered when looking upon the various forms as elementary species. Seeds have been saved of the various plants involved in the picture, and, as yet, nothing can be written as to the constancy of the forms in question. The present purpose is to place on record some of the striking forms of leaves in this most common wayside weed.

It is possible that the smallest and most reduced leaf is from a member of the Red-Seeded Dandelion (*Taraxacum erythrospermum* And.), or it and some others are hybrids between the two species named. This and the whole question of seed production is one full of interest. Correspondence with botanists in regions where only the common kind is met with, confirm the opinion that it is a remarkable plant for its variability, regardless of its association with other species.

THE SHEPHERD'S PURSE (BURSA BURSA-PASTORIS (L.)).

The common "Shepherd's Purse" lends itself to the study of variation in many ways, but in particular as its rosettes of leaves are met with in winter and early spring on nearly every uncovered piece of land left untilled through the autumn months. Plate XX. shows thirteen specimens with the roots removed and photographed from above. The great range in size of the rosettes is incidental as attention is called in particular to the form of the individual leaf. Those with nearly entire margins, as at 6, are very different from those at 1, where the lobes are large, broad and nearly touch each other, and in this last respect quite unlike the widely separated lobes shown at 3. If one fixes his eyes upon the rosette at 9 and then passes to 13 and then on to 10 and to 12, he will be impressed with the diversity of forms exhibited by this species. The variation in the same plant may be slight, as at 3 and 7, but frequently the condition is as shown at 2, where the serrated and divided leaves are borne by the same plant.

THE MAY APPLE, MANDRAKE (PODOPHYLLUM PELTATUM (L.)).

In the "May Apple" as found wide-spread throughout the eastern United States, as an attractive herb in low, open woodland, is a species that it seems probable has not been disturbed by any hybridizing with other species, certainly not with any of its own genus, for it is monotypic so far as this country is concerned.

To the student of plant variation, the "Mandrake" is full of interest, for, aside from the single simple pistil, there is no close adherence to any numerical plan and when it comes to the lobes of the leaves, this disregard becomes phenomenal. Space here will not be taken to describe the many forms, as a study of Plate XXI. will confirm the strong statement already made regarding the variability. Whether the leaf is eccentric or not is usually determined by the number of leaves borne by the plant; that is, when single,

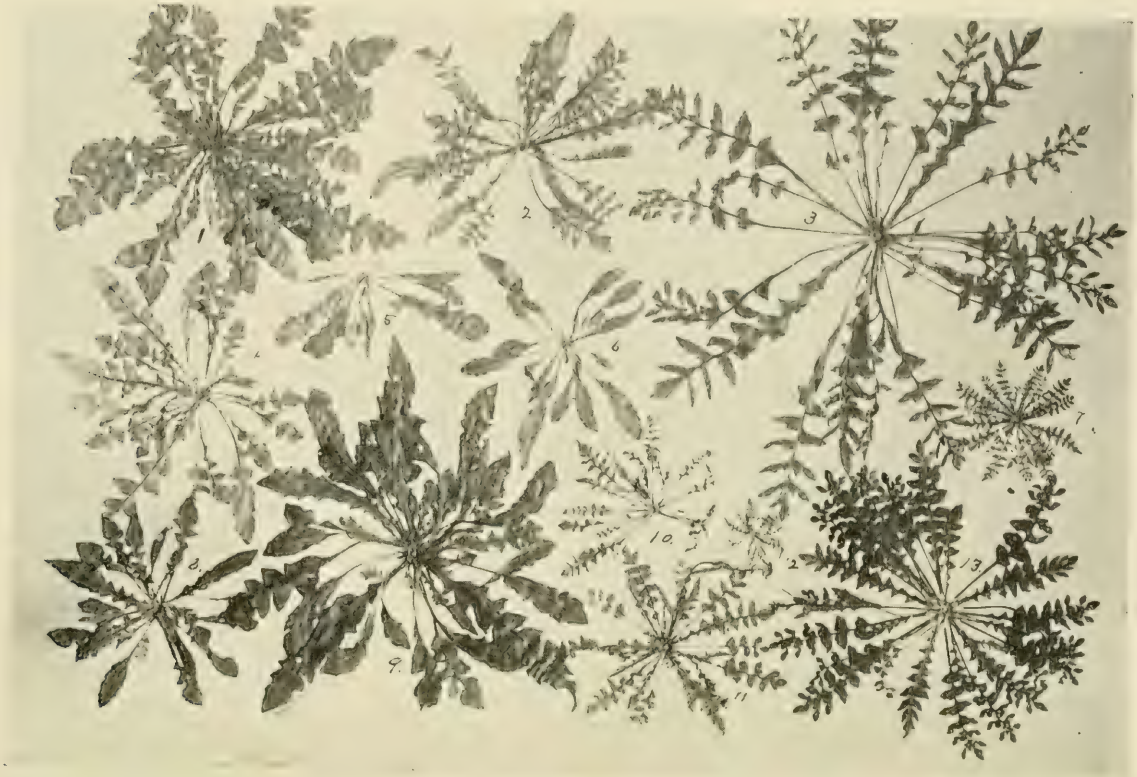
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PLATE XX.

Variability in Wild Plants—A set of 13 rosettes of the "Shepherd's Purse" as found in spring upon corn stubble field.

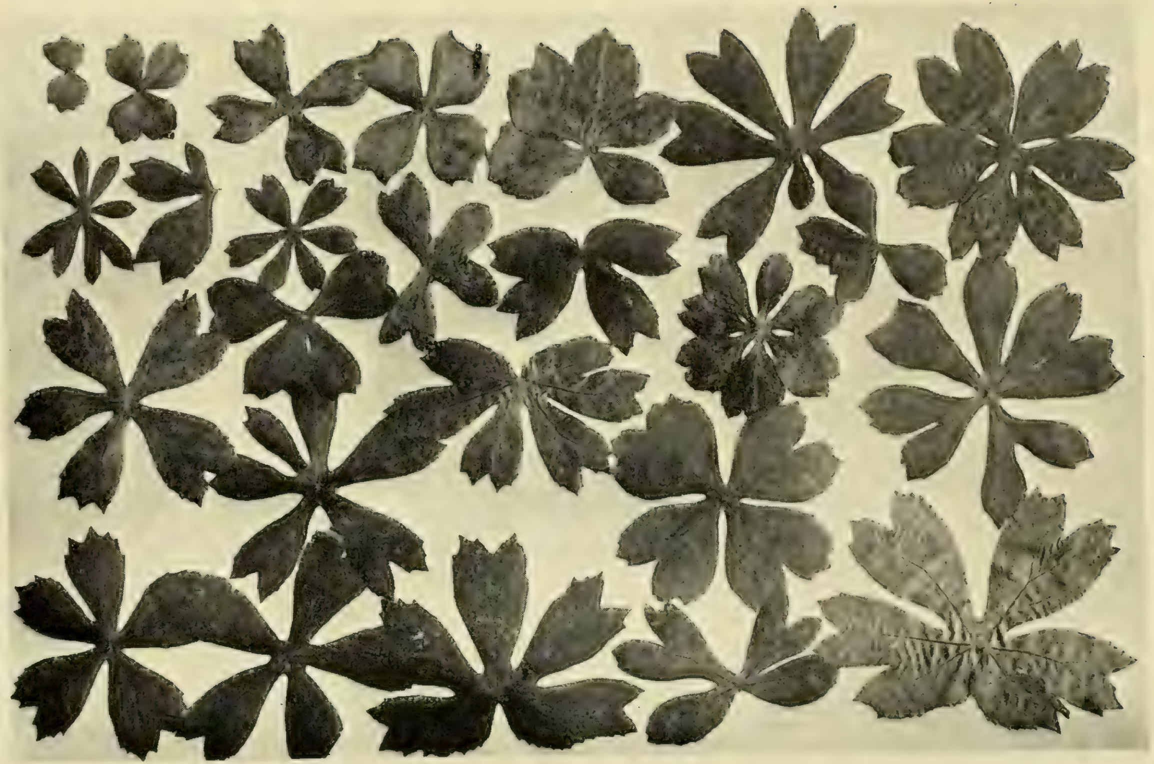

PLATE XXI.

Variability in Wild Plants—A set of 25 leaves of the "Mandrake," showing a wide range of forms.

the lobes are usually arranged around a common center, and when there are two leaves, the blade is one-sided as a rule. In addition to the variations that may be shown by a photo-engraving, there are tints of green and purple and variegation or mottling that are very striking to the eye, particularly when freshly unfolded.

From a superficial study of the colonies of these plants, it seems likely that great variability was bestowed upon some and a considerable amount of uniformity upon other groups that may have a recent common ancestry.

MULBERRY LEAVES.

Another instance of variation in leaf forms is well shown in the Mulberry (*Morus alba* L.) as met with in the wild condition in the neighboring woods. To illustrate this a plate has been prepared of some of the leaves that were gathered from the same small plant. In this case, the leaves with the margin most nearly entire are from twigs that seem to have had the best opportunity for development; that is, certain twigs of unusual length of the season's growth, show leaves that are generally well filled out, and, on the other hand, the small leaves upon abbreviated side shoots are very irregular in outline. While this theory in a general way seems to be sustained by the facts as interpreted by a study of the plant, it is, however, true that striking exceptions are found; for example, there may be a leaf of the entire type and one much lobed, borne next to each other, as shown near the middle of Plate XXII.

It goes without saying that the mulberry is a species in which the form of the leaf has not become firmly fixed. Whether it is tending toward the lobed shape or not, it is difficult to decide; that more than one elementary species is in the making, is another matter requiring further study. For the present, it cannot be more than recorded that upon the same plant the form of the leaf may vary greatly and in such species the full description needs to include the fact.

It deserves mentioning that another type of variation is met with in the mulberry, namely, the formation of "twin leaves;" that is, union in part of two leaves both as to the petiole and a portion of the blade. A case in point is shown above the middle in the plate. This seems to be in the category along with the "four-leaved" clovers so closely associated with "good luck" for the finder.

THE CATMINT (NEPETA CATARIA (L.)).

The common "catnip" is ordinarily considered as a species having a large degree of uniformity in its foliage, but when one is looking for variations they are quite apparent in aspect of the whole plant —color of stem and foliage and in thickness, hairiness and general shape of leaf. As regards the latter, the six tips of branches shown in the left two-fifths of Plate XXIII. are all from the same plant, and the contrast between each pair, 1 and 2, 6 and 7, and 11 and 12, increases from top to bottom. With the fresh tips placed upright in glass vials, the picture was secured with a vertical camera, before wilting has taken place. By making a study of a tip like the one at 2 with its neighbor 3, it is seen that one of the chief differences is in the variation, it being of the true pinnate type in the former and quite largely palmate in the latter, and as a natural consequence the leaf is ovate-lanceolate in 2 and broadly ovate in 3. The serrations are quite unlike in the two, but in some other cases the leaves become entire, and the leaves, &c., like those of the broad-leaved plantain in margin and venation. The nearest to this last-named condition are the leaves at 15; the very coarse serrations of the leaves at 3, 5 and 11 are in strong contrast with the fine notches shown at 2, 4, 12 and 14.

Plants showing these wide differences in the leaves, when taken to the greenhouse and grown through the winter, soon presented comparative uniformity. Spring tips show less variation than autumn grown stems.

THE HEADS OF OX-EYE DAISY.

The forty-eight heads of the common ox-eye daisy (*Chrysanthemum Leucanthemum* L.), shown in Plate XXIV., were gathered one from each plant and from a single field the same day, with the endeavor to show the variations that may be met with in the ray flowers in this meadow pest. In number of rays, the range is from none to forty-five, with the majority centering around thirty-four. The size of the heads is indicated by the use of a strip of

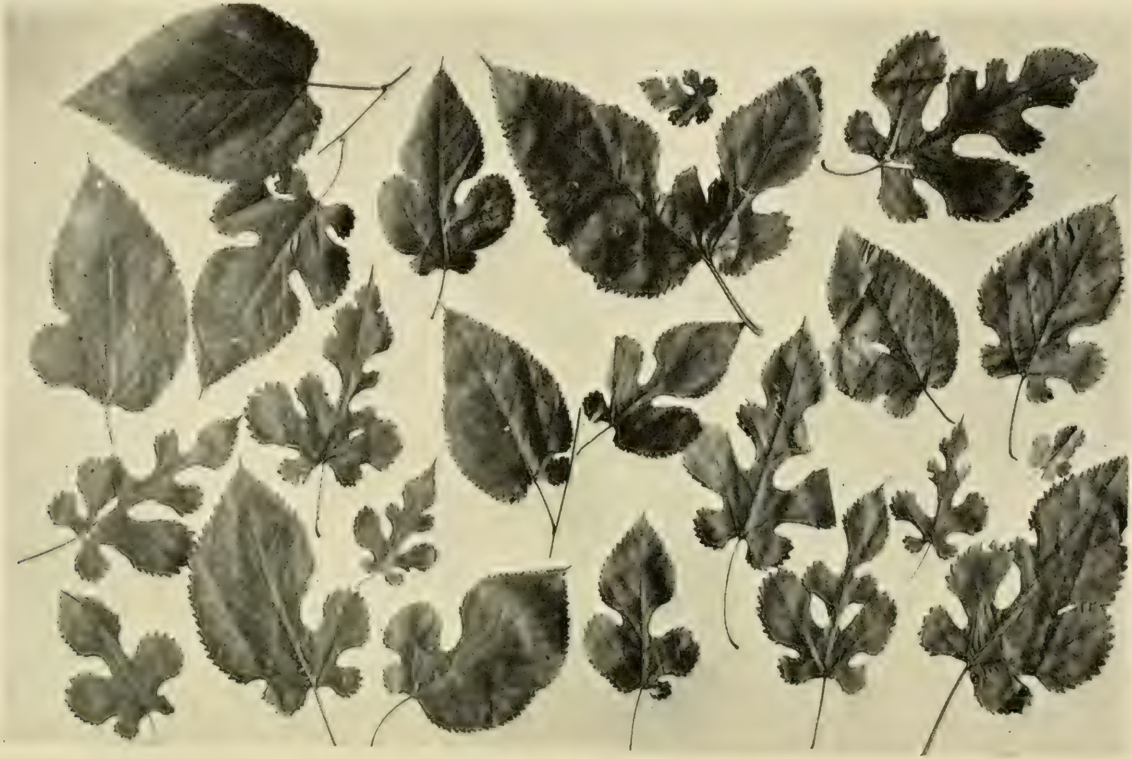

PLATE XXII.

Variability in Wild Plants—A set of 23 leaves of the mulberry from the same small plant; a twin leaf is shown near the upper middle.

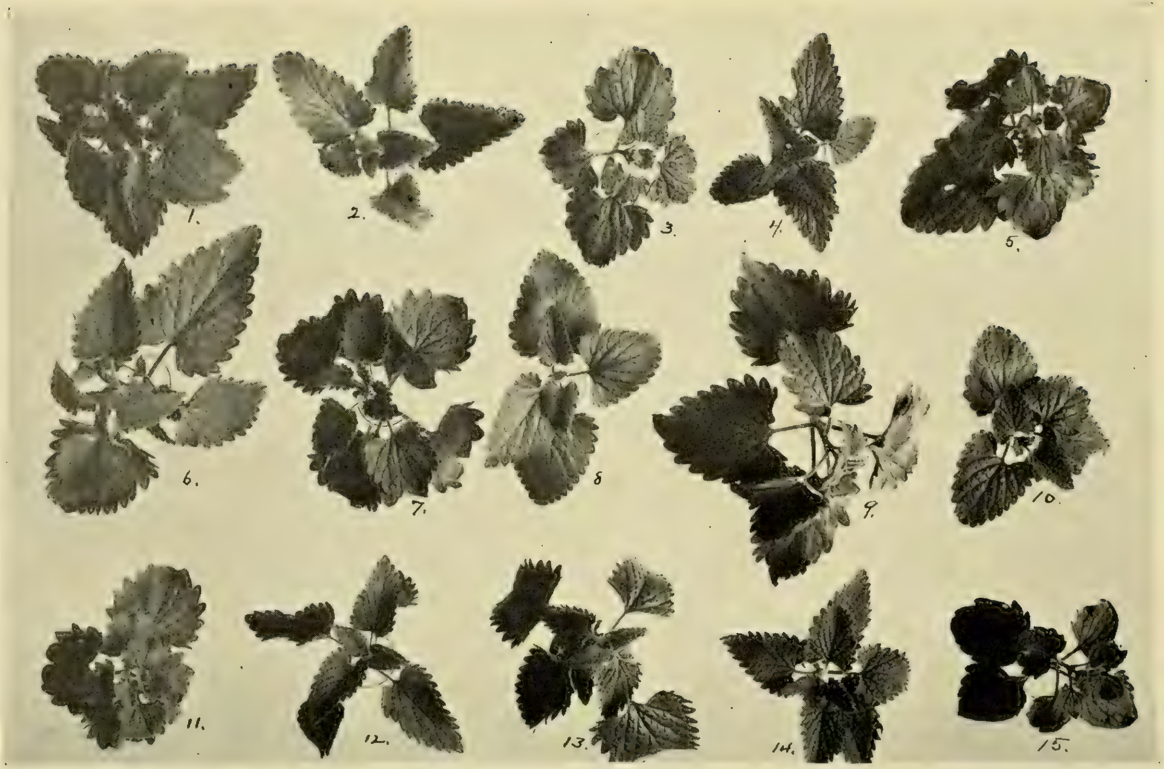
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PLATE XXIII.

Variability in Wild Plants--A set of 15 tips of catnip stems, showing differences in venation, serration, &c

white paper, two inches long, near the middle of the picture and just below the head without ray flowers. In the next row above this and two heads to the left, is a sample from a plant upon which the heads were with the ray flowers all tubular; that is, like the small yellow central flowers in form, but much larger and of the white color of the ordinary ray flowers. Space does not permit of a detailed account of the many variations that the reader may notice by a careful study of the plate. Plants of some of the most showy forms have been grown for years in the ornamental grounds with a view of studying the effect of clean culture upon the more showy portions of the plant.

NUMERICAL STUDY OF THE SEED VESSELS OF THE "VELVET-LEAF."

Last year some attention was paid to the variation of the seed vessels in the "velvet-leaf" (*Abutelon Abutelon* L.), and the results pointed toward the opinion that environment (soil, water, &c.) had an influence in this regard. During the past season some observations have been made upon the relation of position upon the plant to the number of seed vessels.

The Abutelon in favorable situations forms plants that are remarkable for their long lateral stems, so that the spread of the branches nearly equals a half of the height of the whole plant, making the general outline an oval. Associated with each main branch is a small one remaining small, short and terminated with a flower, followed by the peculiar capsule called "butter-print" because of the circular arrangement of the many seed vessels. It is the number and size of those vessels that is herein considered. Upon large plants, above described, the fruits borne close upon the main stem and the largest of all have the greatest number of the seed cavities; in Plate XXV. the fruit shown at the upper right-hand corner is one of these. At the opposite end of the same row is a sample of the fruits produced at the ends of the main branches, while the intermediates produced at intervals along the branches are shown at 2, 3 and 4. The second row show the fruits reversed as to size, and in the third row the basal end is uppermost and the seed vessels observed from below are seen to range from 11 to 15. In some instances the series is extended somewhat as was shown in the engraving in the last report.

It seems to be a fact that fruits that are produced earliest, and situated upon the main stem or near to it, are the largest and have the greatest number of seed vessels, and the reverse of this seems equally true, as above stated. From above facts it is reasonable to reach the opinion that there is a relation between the nutrition of the very young fruit that determines whether the number of seed vessels shall be fifteen or near it, or less. In other words, the same conditions that produce a large fruit in the initial steps of the latter, lead to a large number of seed cavities.

Last season's observations pointed toward the relation between soil conditions and number of seed vessels, and the present note brings the same factor, namely, nutrition, forward as a modifier in the plant itself. The numerous and topmost, late formed fruits, it is inferred, are poorly fed, with the results previously named, and correspond to the single fruit upon the dwarfed, unbranched plant, and consequently located near the main stem.

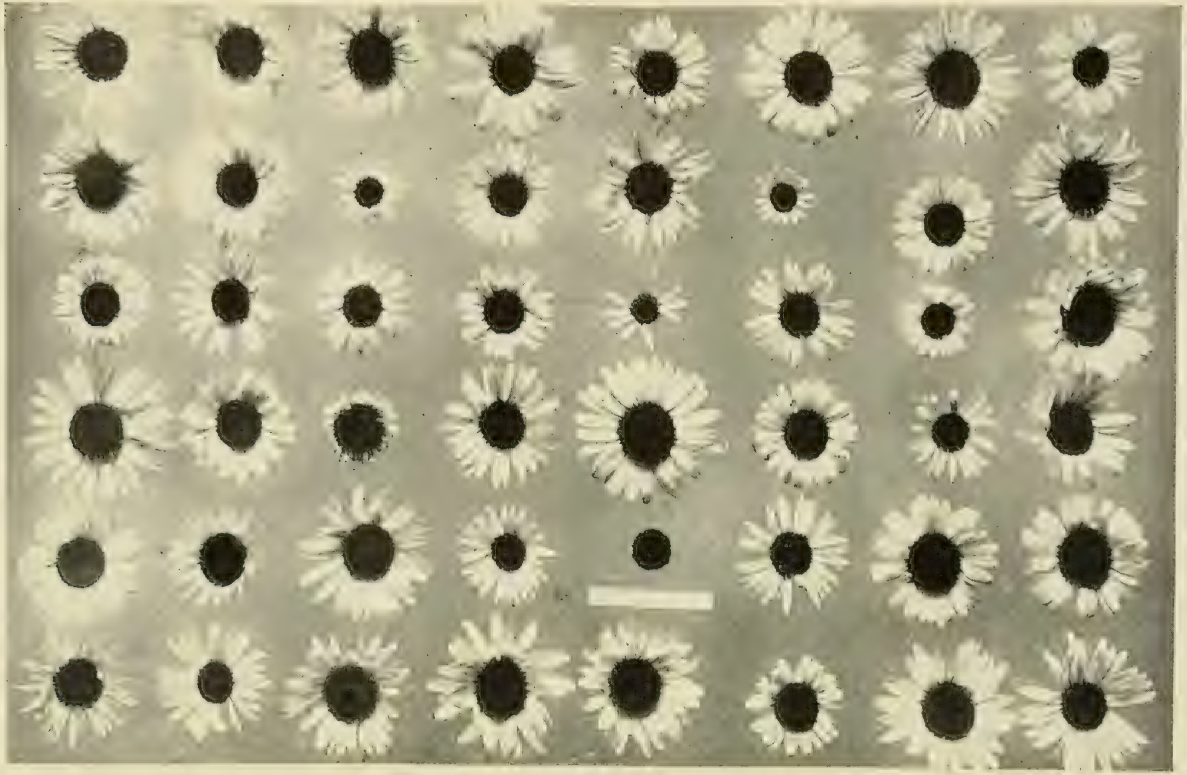

PLATE XXIV.

Variability in Wild Plants—A set of 48 heads of the ox-eye daisy showing much difference in the size of disc, length and number of ray flowers: one without rays is shown near the lower center and above, and to the right of this, is a head with the ray flowers of the tubular type.

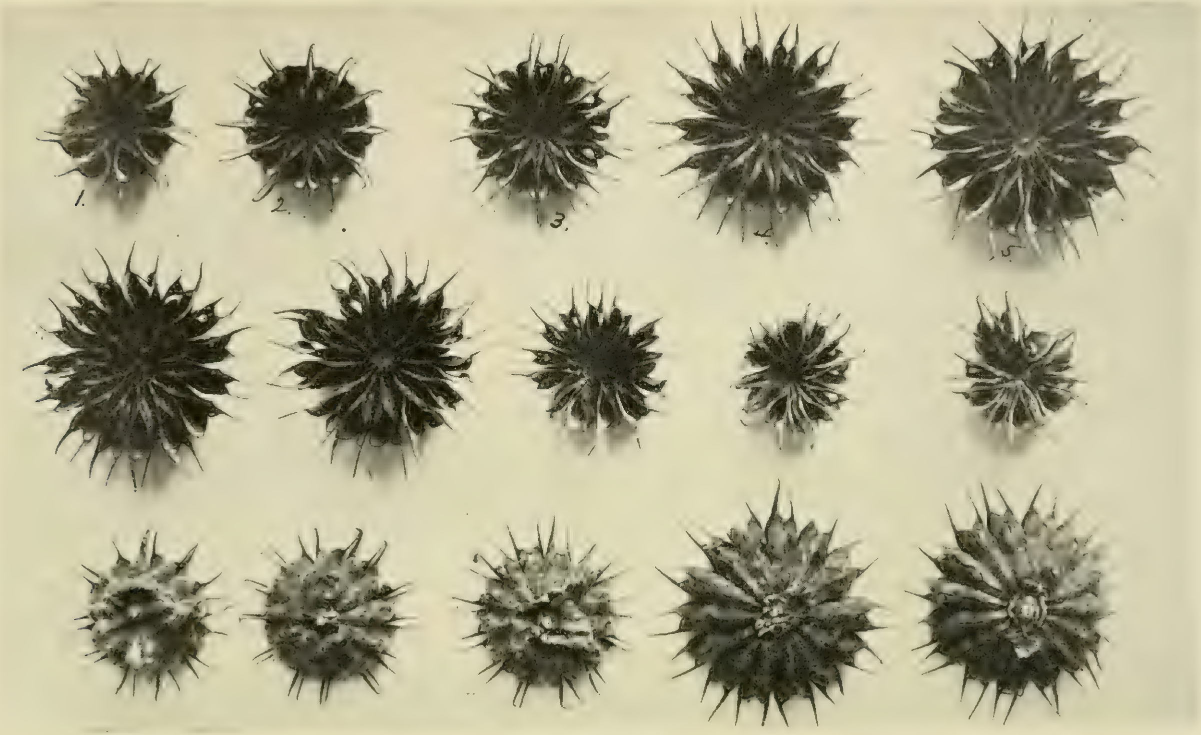

PLATE XXV.

Variability in Wild Plants—Three sets of seed-capsules of "Velvet-Leaf" or "Butter Print" from separate plants, the size and number of seed-vessels apparently dependent upon food supply.

Rainfall of the Growing Season for Past Twenty-One Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	Average.
April	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.43	2.88	3.64	3.78	2.72	5.97	3.57
May	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	1.71	4.21	5.05	7.10	2.30	4.03
June	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.43	4.48	4.41	2.32	3.26	3.61
July	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	4.06	5.58	2.62	4.70	2.12	5.05
August	5.18	4.90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	5.72	5.95	3.45	5.05	4.57	5.01
September ..	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	5.23	2.19	8.08	2.09	3.30	4.00
Totals...	36.87	25.75	21.16	20.85	24.77	24.79	18.13	24.28	31.28	24.16	20.46	27.11	26.64	29.61	28.04	25.44	23.03	26.05	27.39	23.98	21.57	25.30
Average..	6.14	4.29	3.53	3.47	4.13	4.13	3.02	4.05	5.21	4.03	3.41	4.52	4.44	4.93	4.67	4.24	3.84	4.34	4.56	4.00	3.59	4.22
Rank in Wetness	1	9	18	19	12	11	21	13	2	14	20	6	7	3	4	10	16	8	5	15	17	
Rank in Dryness	21	13	4	3	10	11	1	9	20	8	2	16	15	19	18	12	6	14	17	7	5	

Temperature of the Growing Season for Past Twenty-One Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	Average.
April	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	46.7	49.9	51.2	45.2	51.2	50.2	49.9
May	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	62.8	61.4	61.0	55.4	61.6	60.0	60.7
June	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	68.3	70.4	64.7	69.9	70.0	69.3
July	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	72.3	74.4	72.8	73.6	75.6	71.6	73.8
August	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	71.1	74.6	70.5	70.6	70.2	72.1
September...	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	64.8	65.4	68.9	67.1	65.7	64.5	66.1
Average..	65.2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64.3	64.0	64.3	65.1	66.5	62.7	65.8	64.4	65.3
Rank in Warmth...	12	14	11	10	15	4	5	2	16	6	7	1	8	18	20	19	13	3	21	9	17	
Rank in Coldness	10	8	11	12	7	18	17	20	6	16	15	21	14	4	2	3	9	19	1	13	5	

Sunshine of the Growing Season for the Past Twenty-One Years in Percentage of Clear-Partly-Cloudy Days.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	Average.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
April	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	77	83	67	77	70	70.1
May	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	74	77	68	61	68	70.9
June	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	77	73	73	93	63	76.3
July	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	81	81	64	81	75	76.0
August	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	74	68	84	65	65	76.4
September....	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76	80	60	63	60	74.3
Average...	61.5	73.5	72.2	74.8	73.3	74.7	78.2	75.2	80.0	72.5	79.3	80.5	69.5	76.3	72.5	77.7	76.5	77.0	69.3	73.3	66.8	74.0
Rank in Brightness	21	12	17	10	13	11	4	9	2	15	3	1	18	8	16	5	7	6	19	14	20	
Rank in Darkness	1	10	5	12	9	11	18	13	20	7	19	21	4	14	6	17	15	16	3	8	2	

WEATHER NOTES FOR THE GROWING SEASON.

Upon page 329 is given the table of the rainfall during the growing season, April 1st to October 1st, for the whole State, for the past twenty-one years. This season has been the dryest since the century began, and since 1889 has been exceeded by only 1895, 1899, 1892 and 1891. In the last-named year, which was the dryest, the shortage fell largely in August and September, and the results to crops were not so disastrous as the past season, when May, June and July were the dry months, during which the rainfall was only 7.68 inches as against the average of 12.69 for the whole twenty-one years.

Upon page 330 is given a record of the temperatures of the State by months, and it is seen that while there is no wide range here, as with rainfall, the season was a cool one and as a whole ranks fifth, being exceeded by 1907, 1903, 1905 and 1902, and in the order named. When each month is compared with its average it is found that July, August and September were all nearly two degrees below normal. May was also below, but April and June a trifle above the average.

A table for the sunshine is given upon page 331 and it is noted that the growing season just closed was second in the twenty-one in darkness; that is, it has next to the lowest place in brightness.

The season was dry, cool and cloudy, all factors combining to make a poor year for crop-growing.

DISEASES OF PLANTS UPON BREEDING GROUNDS AND ELSEWHERE.

There was but a small amount of fungus troubles upon the home grounds, and, judging from correspondence, there has been less than usual throughout the State. Among beans there was some pod spot, but no mildew was seen and spraying was not resorted to as other matters were uppermost. Some corn smut was seen, chiefly upon the early sorts. The eggplants suffered most of all crops from the drought, some of the plants ceasing to grow and their leaves turning yellow and dying. Among the tomatoes there was some of the leaf blight, but the method of training to stakes, thus keeping the fruits from the ground, may have checked the rots and at the same time increased the cracking, which was quite troublesome where the pruning was overdone, and the sun burned the fruits. The squashes were not up to normal size, due to drought and not from any serious inroads of fungous enemies.

Early in the season there was much complaint of a browning of shade and orchard trees, the maple and apple leading in this—a result of unfavorable weather. The chestnut disease was watched in various parts of the State, and it does not seem to have spread to the extent that was predicted. There was a considerable dodder in the State upon clover and allied plants.

Experiments with Beans.

EARLE J. OWEN.

Plots 1, 2 and 3 of Series VI. were occupied by the "Jackson Wonder" crosses, while a portion of Plot 4 was given over to "Pole" beans. Plots 2 and 3 of Series VII. consisted entirely of plants from selected white seed of the "Jackson Wonder"-"Dreer" set, while the Limas of Plot 4, Series VII. represented strains of "Station Bush" ("Plump" and "Flat") and "Kelsey Bush." Those grown on Strip III. consisted of old varieties, a few novelties, new crosses made in 1908 and the "Scarlet Runner Hybrids."

EXPERIMENTS WITH LIMA BEANS.

The "Jackson Wonder" crosses, which have been under observation during four successive seasons, were made and studied, primarily, with the idea of adding the good qualities of this mottled variety to certain white seeded sorts.

"Jackson Wonder" is a spreading bush lima with a plant and pod which bear a close resemblance to the "Henderson." In other words, it belongs to the so-called "Sieva" type, as distinguished from the form represented by the "Burpee," "Dreer," &c., and, while early and prolific, is not popular, mainly on account of the colored seeds, which, when cooked, do not make an attractive dish.

With the object just stated, six pairs of rows ("Breeders"), six inches apart in each case, were planted (1905) in widely separated parts of the gardens. These pairs were composed of the "Jackson Wonder" in union with one of the following white seeded varieties: "Burpee,' "Dreer," "Henderson," "Willow Leaf," "Woods" and "Station Bush." White seeds from these sets, planted in 1906, gave in each instance ("J. W."*-"Dreer" excepted) large, thrifty, prolific blend plants, which produced solid, dark red seeds—an indication that natural crossing with the "Jackson Wonder" had taken place. Seeds of like color (dark red) were also discovered as the product of certain plants grown from "J. W." seeds, but, as this color has already resulted from a selection of the darkest "J. W." (commercial), these could not be considered as a sure sign of mixed blood. In respect to the "J. W."-"Woods" and the "J. W."-"Station Bush" sets, runners were developed by certain individuals, a character, strongly manifest in later generations. A reference to the annual report for 1906 (page 453) shows that the seed colors are classed in six different groups. The "Brick-red mottled" and "Light-red mottled" have not appeared in every "set" and seem less stable than the other four ("J. W." type, "Dark-red," "Light-red" and "White"). The "Brick-red mottled" was discovered (first generation) only in the "J. W."-"Willow-leaf" and "J. W."-"Station Bush" crosses, the "Light-red mottled" in the "J. W."-"Willow-leaf" and the "J. W."-"Woods" crosses.

Taking these seed colors as a guide, selection was made from the six pairs with the object of learning something in regard to color inheritance. The union of "J. W." with "Woods" produced certain "Viny" plants, which gave rise to a "Runner" set, and, because of this undesirable tendency they were finally discarded.

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* "Jackson Wonder" will hereafter be referred to as "J. W."

TABLE OF "JACKSON WONDER" CROSSES.

Color of Seed Planted.	*Cross Used.*	*No. of Plants Grown.*		*Per Cent. Breeding True.*	
		1908.	*1909.*	*1908.*	*1909.*
"Jackson Wonder."	"J. W. Burpee."	84	52	98.8	69.2
" "	"Dreer."	37	20	67.5	65
" "	"Henderson."	123	27	99.1	88.8
" "	"Willow Leaf."	99	..	70.7	....
" "	"Woods."	41	33	65.8	63.6
" "	"Station Bush."	94	20	74.4	73
"Dark Red."	"Burpee."	30	76	50	85
" "	"Dreer."	193	77	59.8	50.6
" "	"Willow Leaf."	167	78	77.8	66.6
" "	"Woods."	101	87	90	96.5
" "	"Station Bush."	240	80	66.5	50
"White."	"Dreer."	41	414	97.5	78
"	"Henderson."	290	26	98.6	92.3
"	"Willow Leaf."	164	26	97.8	100
"	"Woods."	481	32	96.2	96.8
"	"Station Bush."	92	30	85.5	100

The above table records the principal seed colors ("J. W. type," "Dark-red," White"), and represents an attempt to compare this year's percentage with those for 1908. The seeds of the recent harvest date back to "Grand-parents" of the same color; that is, from the "Dark-red" of 1907, a selection was made which produced the dark red seeded plants of 1908, and ten of these, yielding in turn the same type of seed, were selected for this year's crop. It is not yet proved that the "Dark-red" will transmit its color without an occasional exception, nor can the parent types be considered as established.

That the dark red seed can be obtained by simple selection from commercial seed, has been shown by the following experiment. From a quantity of "J. W." beans, some of the lighter mottled were taken (1906), also those which came nearest having a solid, dark color, and plantings were made from each, care being taken to grow them as far apart as possible. The result at harvest time is well illustrated in Plate XII. (Annual Report, 1906), number 3 showing the "Selected dark" lot and 5 the "light," with the Commercial "J. W." at 4 for comparison. For the 1907 planting the darkest were chosen from 3 and the lightest from 5, the crop yielding, in respect to the dark red, more seeds of a solid color than those of the preceding year, but the "light" selection shows no apparent gain. In continuation of this line of work, the "light" strain being discarded, the result of planting from solid dark seed (ten selected plants, 1908) has produced seed this year 85 per cent. of which bred true, or 15.3 per cent. more than the average for the same color in the crosses. (See table.)

The Blend plants of the "J. W.-Dreer" cross, which were not obtained until 1907 developed strong runners in certain instances, one in particular being noticed on account of the large leaves, lighter green than those of the "J. W.," and its large pods, similar to the "Dreer" in form, but less plump. The large, flattish, dark red seeds had the same shade of red as the others of the set. The greenish white, plump seed gave rise to a fine set of offspring, more than half of which were runners, and only one yielded colored seed, while many inherited the desired plumpness. This year twenty-nine of the best "Thick" white-seeded plants grown in 1908 were represented, more than half developing runners while an occasional "Willow-leaved" type occurred. These, on the average, were earlier and more prolific than the "Dreer," and, although the seed has never been found equal to that of the white parent in size, it shows the desired "meatiness" in about 50 per cent. of the cases where that form of seed was planted. The color of the "Dreer" Lima should be described as "greenish white," and many of the offspring resulting from its union with "J. W." yield seed of a greenish tinge, in some instances more pronounced than that of the "Dreer." Selection has been made in respect to this trait, and although no data are at hand showing to what extent this tendency is inherited, a comparison of the 1909 crop with that of the year preceding, shows a decrease in the relative number of plants yielding greenish-white beans.

The "Station Bush" ("Flat" and "Plump") strains have been continued with a result from selecting which emphasizes the importance of this work, as the two sets would not be recognized as having like parentage. "Kelsey" Lima, as marked by earliness and good bearing quality, is well established.

POLE BEANS.

"SPECKLED LIMA"-"WILLOW-LEAF POLE" II.

In 1907, at harvest time, a climbing plant with coarse "Willow-leaf" foliage and large, flat pods, containing mottled seeds was discovered among the "Willow-leaf Pole" plants—the beans of which in their markings resembled "Speckled Lima," an old variety whose seeds are blotched with reddish brown. As the "Speckled Lima" had been grown near the "Willow-leaf Pole" in 1906, it was considered to be the male parent of this "Suspect," which, unlike the union of "J. W." with a white Lima (giving dark-red in the blend), was found to be a mottled bean. Although the first generation plants of 1908 were all "polers," none inherited the foliage of the mother ("Willow-leaf"), while the pods were smaller than those of the "Speckled Lima" with a smoother surface. The seed not so large as its mottled parent, varied somewhat in its markings, but none gave a solid color, white resulting in only one instance. The plants of this season were grown from the two selections of "Mottled Brown" and white. Eighteen individuals represented the former and produced mottled beans in seventeen cases, the other being white.

In regard to one plant, a new form of mottling appeared, in which the medium-sized, flat seed was red, with the exception of a few lighter markings. The progeny grown from the white seed numbered ten, with a leaf varying from light to dark green, the pods being medium to large. Eight plants produced white, and two mottled beans.

"JACKSON WONDER"-"DREER" POLE STRAIN.

The parent was a "Runner" and bore 133 pods with light red seeds. This was selected as a new pole sort and produced eight climbers, six yielding white, one mottled and but one light red seed. Four other "J. W."-"Dreer" "Runners" chosen from the 1908 crop, were grown and gave in all fifty offspring, thirty-four of which required poles and sixteen were bush, the progeny of the selected white parents (two of the four) breeding true to color in all but one case.

THE "SCARLET RUNNER"-"TENNESSEE HYBRID" (63/43).

A union of the two species, *Phaseolus multiflorus* and *Phaseolus vulgaris,* is here represented. The former ("Scarlet-Runner") is prized for its long spikes of bright red flowers, a color not met with among our varieties of *P. vulgaris.* It has a dark stem and large, dark green leaves, distinguished from those of the common bush form by their smoother surface, resembling somewhat the foliage of the Lima (*P. Lunatus*). The large, green pod has a rougher surface than the ordinary snap sorts and contain a large, flat seed which may be described as "mottled purple" and, in size and color, is quite distinct from any bush variety. The "Tennessee" (43) is a standard, green podded, snap bean, with white flowers and brown seeds.

The blend plants of this hybrid (1905) were all runners (with the exception of an abnormal form which did not develop), and bore a strong resemblance to "Scarlet Runner" in general plant habit, being easily trained to poles. They bloomed profusely until checked by frost, but the flowers, although of a decided red, lacked the brilliant scarlet which is characteristic of the climbing parent. The pods, few in number, were between the two parents in size and had the tough quality of the male (63) with smaller seeds of similar coloring ("mottled-purple"). The following season (1906) thirteen first generation plants were grown, showing much variation in habit of growth, color of flower, form of pod, size and color of seed, prolificness and season. (See Annual Report, 1907, pages 346-347.) The most promising plant of this set was number four (B-4) which bore the following record: "Plant large and spreading, with purplish stem and red flowers, pods medium long, curved green, stands first in prolificness, and, like 63, has a long season. The seeds, packed closely in the pod and angled at the ends, are 'grey' in color with fine bluish mottlings, becoming darker near the eye ('grey-mottled')." With this plant as a starting point, certain of its offspring have been selected, particularly with reference to the distinctive flower and seed color of (B-4) in the hope of establishing a type, which shall possess these two characters. The plants of the second generation (1907), grown from the seed of (B-4), numbered thirty-two, the seed colors being grouped as follows: Ten plants similar to the parent ("grey-mottled"), ten white, two mottled dark brown and one mottled ochre brown. In 1908 seed was saved almost exclusively from plants which, by their flower (varying shades of red), &c., gave evidence of "Scarlet-Runner" parentage. Seeds of 63/43 IV. planted this season, represented thirty individuals, all of which had borne flowers of the required color shades, and in nine instances, the "grey-mottled" seed was associated with the red flower. The offspring from the thirty parents (343 in number) were less variable in plant habit than were those of former years, nearly two-thirds adhering to the bush form. Fifty-six per cent. approached the parent in color of flowers, while 44.7 per cent. were similar in markings to the kind planted. In one instance (B-4-2-2) having "rose pink" flowers and "light grey-mottled" seed, all but two of the plants gave reddish blossoms, and 95 per cent. yielded a "light grey-mottled" seed, uniform as any standard variety.

The tracing of B-4 through its offspring to the fourth generation represents an effort to show that certain traits, as flower and seed color, are more or less constant and are often inherited as associated characters. From the standpoint of variation this hybrid presents many problems. The flowers give not only the varying shades of red, but the ordinary white and "pinks" of the snap bean. A large number of the plants are classed as "Runners," a tendency which shows the "Scarlet Runner" influence, but the bush type is the one desired and about half of the offspring have possessed that habit of growth. The pods, 99 per cent. green, have given the varying forms and sizes to be found among the bush varieties of *P. vulgaris,* some being long and flat, others short and plump, while many present a striped appearance. The most constant seed colors have been "Dark mottled" (including "Mottled-purple"), "Grey mottled" and "White." Besides these all intergrades have occurred, as "Brown," "Mottled-brown," "Grey," "Dark-eyed" and "Nondescript."

Last year (1908) wax podded plants, associated with the red flower, were discovered, seed being saved for further planting and study. From plant B-12-2-1, which had a salmon flower and a short flat wax pod, twenty-one offspring were grown—all bush plants medium to tall in height, with a green stem and large leaves. In seventeen instances the flowers were "salmon pink" (fourteen being white) while all bore wax pods. It is desired, by further selection, to obtain a salmon flowered bush variety bearing a wax pod.

SNAP BEAN CROSSES.

Since the beginning of this work (1904), over one hundred actual crosses have been made, the result of artificial pollination, and represent more than fifty of the standard varieties. The initial motive was the production of desirable new strains through the process of systematic breeding. As a practical result seeds of two new wax and one green-podded variety have been sent out for testing. They are "Station Snap" beans (1), (2) and (3); (1) being "Jones Stringless"-"Golden Wax" (131/130), (2) "Longfellow"-"Marrowfat" (26/29) and (3) "Golden Scimitar"-"Davis" (129/111). A white seeded sort is represented in each case, this being one selected from each cross, and the reason for this lies in the fact that a dark bean shows its color when cooked and renders the dish less attractive.

The seeds of *P. vulgaris* present good material for the study of color inheritance by reason of their many color markings, the principal ones being black, brown, red, yellow and white, besides various mottlings. When black and white seeded sorts are united, the result (blend) is usually a dark mottled bean. In the first generation (white and black) the colors usually break up into three types, those representing the two parents and mottled. In the union between a black or a white and a dark-eyed strain, four different markings at least may be expected, black (or white) mottled, mottled eye and dark eye. One cross in particular ("Crystal Wax"-"Market Wax" 145/135) is of interest from this standpoint, alone representing the union of a white and a light brown seed. The blends were quite uniformly "dark-mottled" and a large number of plants were obtained in the first generation, yielding seed which showed a remarkable variation in respect to its markings. These were classed as "Black," "Brown," "White," "Mottled-brown," "Light-brown" and "Grey." Each was planted separately (1908) and the harvest recorded about 50 per cent., adhering to type, being highest in case of the two parent colors (white and light brown). Selection along the same line this year points to a fixation of the six strains.

NOVELTIES.

258. *"Black Turtle Soup."* This is not a "snap" variety, but was grown for its promise as a "Breeder," having a purplish stem and very dark green leaves, with medium small, flat pods, strongly marked with purple and containing small black seeds.

260. *"Stringless Refugee."* There was a poor showing of plants which, in general, resembled "Keeney's Refugee."

261. *"Michigan Wonder Pea."* A prolific, medium early sort which is similar to the common field "Pea-bean" in respect to pod, plant and seed characters.

262. *"Green Prolific Pole Lima."* Plants of this variety were thrifty, strong climbers with large leaves, and bore large, flat green pods, containing large white seeds.

263. *"Improved Purple Wax."* This proved to be another "black wax" variety.

265. *"Hingham Pole."* A poor climber, producing long, round, curved, carmine-striped pods which were stringy and had a long, curved spur. The seeds averaged six to a pod and were medium large, round and red.

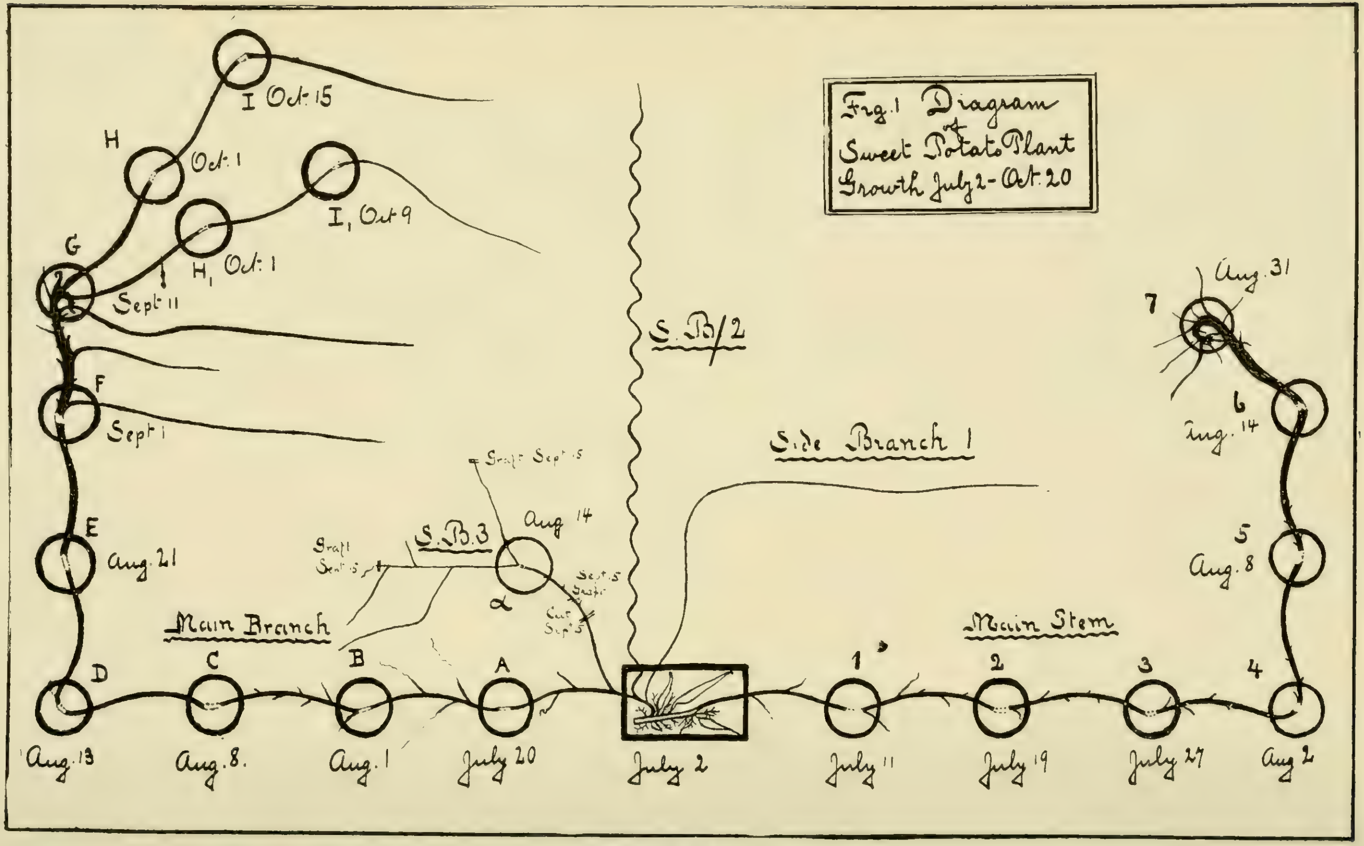
Fig. 1 Diagram of Sweet Potato Plant Growth July 2 - Oct. 20
I Oct. 15
H
Oct. 1
I, Oct 9
G
H, Oct. 1
Sept 11
S. B/2
7
Aug. 31
6
Aug. 14
F
Sept 1
Side Branch 1
Graft Sept 5
S. B. 3
Aug 14
Graft Sept 5
Sept 5 Graft
Cut Sept 5
α
E
Aug. 21
5
Aug. 8
Main Branch
Main Stem
D
C
B
A
1
2
3
4
Aug. 13
Aug. 8.
Aug. 1
July 20
July 2
July 11
July 19
July 27
Aug 2

PLATE XXVI.

Circulation in Plants—Diagram showing plan of experiment in circulation in Potted Sweet Potato plant.

CONTRIBUTION TO THE STUDY OF CIRCULATION.

STUDIES ON THE SWEET POTATO (Ipomœa batatas).

[Preliminary Report.]

B. H. A. Groth, Ph.D.

The running varieties of the sweet potato thrive in the summer heat of a greenhouse, grow very rapidly, and may be rooted with ease at any joint, or as easily kept from rooting. They furnish, therefore, excellent subjects for the study of the effects of various treatments on the rate of growth. This paper is a preliminary report of an investigation of the "Reversal of the Water Current," caused by withholding water from the lower joints and supplying it to the upper ones.

On July 2d, 1909, a piece of vine of the variety "Big Stem Jersey," which had one side branch, was planted in a box in four inches of soil, so that the two tips, one of the "Main Stem," the other of the "Main Branch," protruded from the soil. The temperature in the greenhouse ranged throughout July and August from a minimum of 65–75° F. to a maximum of 95–105 every bright day, and rarely fell below a minimum of 65 or below a maximum of 90 on any day. The daily maximum gradually decreased in September to 80–90, and the minimum to ±60. On October 15th the furnace was started, and since then the temperature is maintained at ± 70°.

By August 15th the "Main Stem" had been rooted in six pots (pots 1–6, Fig. 1) and the "Main Branch" in four. The "Main Stem" had developed only small side branches, none of which measured over six inches. The "Main Branch" had three large branches, hereafter called "Side Branches 1, 2 and 3," between the box and the first pot (pot A, Fig. 1), three others fairly long, between pots A and B, and several small ones. Side Branch 3 had been potted the day before (pot δ) and had, therefore, not yet rooted. The pots were placed ±2 feet apart. Owing to the length of the internodes, which ranged up to five inches, it was not possible to make the distance between rooted joints exactly the same. Side Branch 1 was not rooted, and Side Branch 2 was trained to climb up on a string. Fig. 1 shows the numbers of the pots and the dates at which the vines were rooted in them. The whole plant had a healthy appearance and was growing rapidly.

On and after August 16th, the box and pots 1, 2, A, B received no water. All other pots were given abundant water once a day, as before. On September 5th Side Branch 3 was severed from the Main Branch between the box and pot δ, as shown in Fig. 1. These two operations had the following effects:

Side Branches 1 *and* 2 could now receive water only by means of a reversed circulation through either S. B. 3, M. B. or M. S. As the two branches behaved very much alike, S. B. 2 growing generally a little faster, the record of S. B. 2 only will be considered. (See Fig. 2.) On August 12th and 13th, S. B. 2 grew 2.5 inches per day; the rate rose to three inches on the 14th and to 3.25 on the 15th. On August 16th, *i. e.,* in the twenty-four hours from August 15th, 8 A. M., to August 16th, 8 A. M., the growth registered was 2.5 inches. On August 16th it received no water, and the rate of growth dropped to one inch on August 17th, rose to two the next day and then dropped again, until it stopped entirely on August 21st. At no time was the branch wilted, although the thermometer registered 96° F. in the shade in the greenhouse on August 16th. Growth began again on August 26th, at the rate of 1, 2.5, 2, 3.25, 3.25 inches a day, to drop again to 2:25, 2, 2.25, 2 and 2.5 up to September 5th. On September 5th the connection between the nearest watered pot, δ on S. B. 3, was cut. The rate of growth dropped immediately to one inch for two days. It recovered and dropped again on account of several successive cloudy days, then rose again rapidly, only to drop suddenly on September 19th. On September 24th growth had been reduced to less than 0.5 inches a day, and it remained at that figure. From September 24th to October 25th the total growth was eleven inches. On September 19th the first pair of opposite leaves appeared—usually a sign of coming fasciation. Side Branch 1 developed its first opposite leaves on October 6th.

The "*Main Branch*," as shown in Fig. 2, was increasing its rate of growth rapidly before August 15th, and had reached a rate of over five inches a day on August 10th. In both the M. B. and the M. S. the rates of growth were averaged from observations taken every third day, except directly after August 15th and September 5th, when daily notes were made. On the 16th the growth rate dropped to two inches; to 1.25 the 17th, remaining there until the 20th. Then it rose again steadily, until on September 5th it had attained a rate of over three inches. September 6th the rate dropped to 1.75 inches, and continued to decrease until no further growth was noticeable on September 11th.

The first opposite leaves had appeared on August 6th. They were on the joint rooted in pot C on August 8th. From then on the M. B. had gradually become fasciated, until it formed a ribbon three-fourths of an inch wide. As the branch only grew eighteen inches after leaving pot F, it was rooted at that distance in pot G. The ribbon grew unequally on the two sides, curved, and cracked on the longer side. Posterior to the crack, branches began to arise from the nearest leaf-axil in each case, and at the same time (about September 9th), several other branches sprang from leaves between F and G. About September 19th the broad tip, by unequal growth of different portions, resolved itself, without splitting the epidermis, into several shoots, as indicated in Fig. 1, and many more branches arose all over the distance F-G. Some of these remained fasciated, some appeared as simple branches and soon became fasciated, others have so far (October 25th) remained simple. Four of these branches grew much more rapidly than the rest, and their total daily growth, which is given in Fig. 2, under "Main Branch Rosette," amounted to about seven and one-half inches.

Of all the side branches which had sprung from the M. B. previous to August 15th, between S. B. 3 and pot C, none increased in length after August 16th, and all which were longer than two inches soon began to turn yellow, lose leaves and dry up from the tip back, while the very shortest changed only from a rich dark to a lighter yellowish color. The longest are now (October 25th) dried down to the two basal internodes. Not a single side branch has formed since August 16th between pots C and F. The foliage has gradually become lighter in color from the box on, until now that color has reached pot F. All leaves have dropped between the box and pot A, but none so far between pots A and B. The color of the foliage from pot F on is a rich dark green.

Main Stem.—Before August 16th, the M. S. had maintained a uniform rate of four inches a day, for twenty days. On August 16th, the rate dropped to two inches in one day, and continued to drop more or less evenly until it stopped on August 31st.

The first opposite leaves had appeared on July 25th on the node rooted in pot 3 on July 27th. After that the stem gradually became fasciated. On August 15th it was already half an inch wide. On August 31st the tip, having grown only about eighteen inches since passing pot 6, was rooted in pot 7. The then very broad tip curved around, cracked, and resolved itself into several branches, as described under "Main Branch," with the difference that none of the resulting branches assumed a rapid rate of growth, so that now (October 25th) the longest branch measures scarcely ten inches. The total growth of all branches, given in Fig. 2, as "Main Stem Rosette," does not amount to one-half inch per day.

All leaves on the main stem have gradually become lighter in color since August 16th, except those in pot 7, which are normal, although not as dark as those in pots F, G, H, &c.

Between the box and pot 2, and half-way between pots 2 and 3, all leaves have now dropped.

Of all small branches started all along the stem between the box and pot 5, not one has increased in length since August 16th. The longest, near the box, were at that time six inches long. At present all small branches from the box up to between pots 3 and 4, *i. e.*, between two watered pots, have dried back from the tip, the basal ones most.

Side Branch 3.— Before August 16th, S. B. 3 was growing at an average rate of three inches, keeping pace with S. B. 1 and 2. On August 14th it had been potted in pot *δ*, but had, of course, not yet rooted well. From August 16th until August 21st the tip stood still and turned yellow, and the four basal leaf axils sent out shoots. On September 5th the most distal shoot had a length of six inches, the next four, the third two, and the basal had just started. After September 5th, the proximal shoot assumed the greatest rate of growth, and the apical the least, so that on September 19th the lengths of the four shoots were: basal, 15 inches; next, 12 inches; next, 4 inches, and apical, 6 inches.

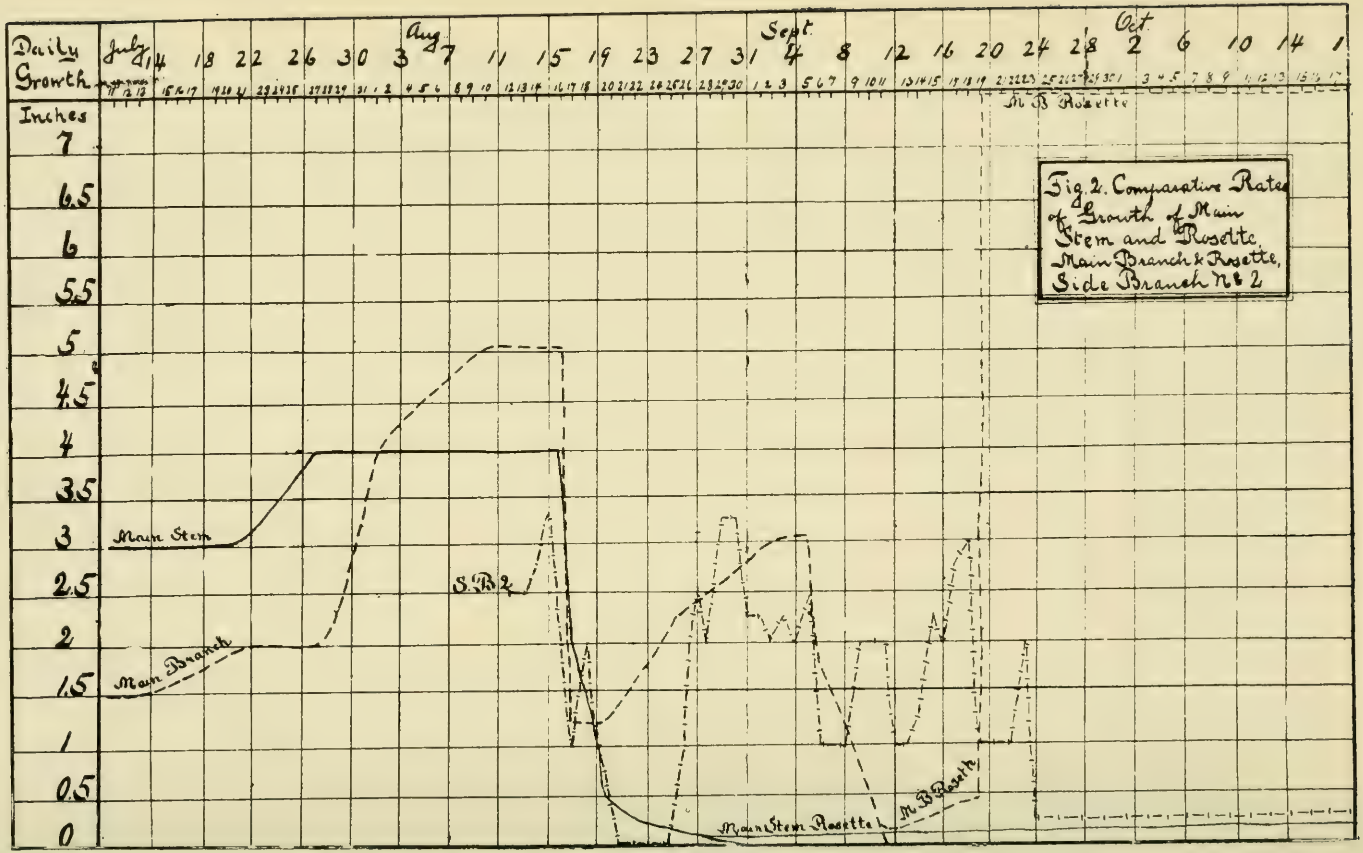

PLATE XXVII.

Circulation in Plants—Diagram showing rates of growth of portions of Potted Sweet Potato plant.

On September 15th an attempt was made to graft the tip, basal branch, and the piece which was cut on September 5th and left attached to S. B. 3, to shoots of the Main Branch between pots A and B, one graft of the basal end of S. B. 3 upon the basal end of one of the shoots, and two of the apical ends of S. B. 3 and its basal branch upon the apical ends of other shoots. In all cases the current would be reversed in that portion of the graft in which it was already reversed before the graft. As was to be expected, all of the grafts failed.

The portion of S. B. 3 extending backwards over pot 3 to the point of separation of September 5th has kept green until now (October 25th), but the leaf farthest away from the pot became yellow and dropped on October 7th, while the small branch springing from this leaf is turning yellowish also.

The Roots.—On August 25th, when the soil was perfectly dry, some of the roots in the box were carefully laid bare and examined. They consisted of potatoes up to nine inches in length and about one inch in diameter. All large roots and all small rootlets were perfectly turgid, and no dried up roots were found. Dry raphia bands were tied around several of the larger roots, and these were then covered up again with perfectly dry soil. On September 20th and October 4th they were again examined and were found to be decreasing in circumference, as the raphia bands were very loose upon them. On October 12th they were found of the same size as on October 4th, and additional bands were put on, labeled with tags so as to distinguish them from the old ones. On October 20th the bands of August 25th were found to be tight and immovable on the roots, while those of October 12th were lying in shallow indentations, but had not cut into the skin.

The dying of the leaves and branches between pots 3 and 4 pointed to an insufficient supply of water, which might arise through diseased roots in pot 3, which was well watered. On October 20th, some of the roots of pot 3 were laid bare. None of them had enlarged into potatoes, but all were found to be apparently healthy and vigorous.

Discussion.—Through numerous experiments of Strasburger (Leitungsbahnen) and others before him, it has long been known that a reversal of the water current in plants is possible, without apparent detriment to any part. Two trees which had branches grown together would continue to keep green and grow after the stem of one of them had been cut off from the root. Shoots of willows and other plants, when planted upside down, would root and grow as well as normally planted shoots. None of these experiments, however, allowed an accurate study of the immediate effects produced on the rate of growth by such a reversal of the current. To permit this, the reversal must be brought about without any mechanical injury. This is possible in a plant like the sweet potato, in which time of rooting, place of rooting and water supply of all roots can easily be controlled by pot-growing in the greenhouse, as shown in Fig. 1.

This preliminary report deals with that phase of the investigation in which the effect of the first reversal is studied.

A study of Fig. 2 and the other results given reveals the fact that from August 16th on, when the regular daily supply of water was first withheld, all parts of the plant, the watered as well as the unwatered, were abruptly checked in their growth. Again, on September 5th, when one of the three sources of water supply was cut off, without injury to the growing parts under study, all rapidly growing parts (and possibly also the others), were checked again. This checking of growth might be the result of an inadequate total water supply, caused by the lack of water in two out of four pots in M. B. and in the box, and two out of five pots in M. S. It must be considered, however, that other branches were growing in the greenhouse at the time which had made a growth of eight feet, were growing at a rapid rate, and yet were rooted only at one joint in a single pot. On the other hand, it is possible that the reversal of the current *per se* interfered temporarily with a proper water supply to the well-watered, growing parts. Experiments are now under way to determine which of the two possible explanations advanced is correct.

It is further of interest to note that the recovery of the rate of growth of S. B. 2 seems dependent on the rate of growth of the watered parts. For example, from August 25th on, the rate is rapidly increased, at the same time when the rate of the M. S. is sinking to O or is maintained very feebly by its rosette. Again, on September 18th, the rate drops soon to sink to a very low level, at the time when the rosette of M. B. begins to grow rapidly in several branches at once, making a total rate of increment of about seven and one-half inches. This suggests that the two currents, which must from a certain point in both the M. S. and M. B. flow to opposite sides, may vary considerably in strength.

Furthermore, the total amount of increment in length of all three branches plotted in Fig. 2 never reached the total after August 16th which it had before. This would be still more striking if all the smaller branches were taken into consideration which stopped growth altogether.

It may be objected that the appearance of fasciation, which is very common in some varieties of Ipomoea batatas, interferes with the results. The experiment will be repeated with other plants, if necessary with other varieties; but it is shown in this paper how both the M. B. and the M. S. made their heaviest growth after they became fasciated.

In Strasburger's experiments, in which the course of the water current in inverted plants was traced with eosin, the water flowed reversely up the stem and descended the branches in the order in which they were met on the way. If in a living plant a reverse current would flow accordingly and continue to flow so, in case of an insufficient amount of water the branches farthest away from the water supply would be the first to dry up. In the present experiment, however, the three branches farthest away from both main supplies of water were the only ones which did not dry up. S. B. 1, 2 and 3 are the three most basal branches of M. B. If they got their water from C and D, the current passed all the smaller branches on the way without nourishing them sufficiently to grow or even to keep alive. If the water came from pots 3–6, it passed the smaller branches on that side and then went into M. B., from where it ascended in the normal direction. That seems to point again to the conclusion that it was not the diminished water supply, but the direction of the water current, which caused the disturbance in the rate of growth.

Whether the reversal of the comparative rates of growth in the four branches of the S. B. 3 before and after September 5th is significant, further experiments must decide. In the field non-fasciated sweet potato vines have never been observed by the writer to have the apical branches developed faster than the basal ones.

The decrease in the size of the roots between August 25th and October 12th, when S. B. 1 and 2 were actively growing all the time, may perhaps be explained by an increased evaporation, which followed the removal of the soil, and with it the breaking of many smaller roots. Experiments will be continued to determine this. But the fact that the roots can increase in size when in perfectly dry soil, as they did between October 12th and October 20th, proves that rooted branches of the sweet potato may under certain conditions help to increase the root crop of the main plant.

REPORT

OF THE

BOTANICAL DEPARTMENT

OF THE

New Jersey
Agricultural College Experiment Station

New Brunswick, N. J.

FOR THE YEAR

1910

PATERSON, N. J.
News Printing Co., State Printers.
1911.

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REPORT OF THE BOTANICAL DEPARTMENT.

Report of the Botanical Department.

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B. H. ALFRED GROTH, Ph. D.   MARY ROBINSON, Ph. B.*

The investigations in the above department during the past year, in a general way, may be grouped under the following projects:—1. Plant Heredity; 2. Plant Toxicology; 3. Plant Sap Circulation; and 4, Plant Shading.

1. PLANT HEREDITY.—Inheritance in plants is being studied in the following truck crops:—beans, corn, eggplants, okra, peas, peppers, squashes, and tomatoes.

In continuation of the work begun under the Hatch Act, some attention has been given to promising sorts that were in the process of becoming fixed, but the chief effort has been to lay a foundation for the determination of rules of inheritance that may be of general application. To this end during the past year, special emphasis has been laid upon the behavior of tomato crosses in their first generation. The types selected have been bred reciprocally with each other and the plants extensively studied from seedlings to full maturity. Seed has been saved for a similar investigation of the plants of the second generation. In this connection, for example, a microscopic study of the fruit skins of the various types of tomatoes has been made and the results published.†

Considerable space has been given to eggplants, both in crosses of several generations of the "American" sorts and also the hybrids with the "Chinese" species.

In a similar manner, the work in breeding beans, both among crosses and hybrids has been prosecuted.

A somewhat extended study has been made of the leading types of peppers as a foundation for an investigation of crosses that have been secured between them. A comprehensive knowledge of the subject as represented by the commercial plants and their offspring under the particular environment of the breeding grounds has become more and more imperative as the work in inheritance is centered upon particular factors of the plants. Some stress has been placed upon the effect of fertilization (1) within the flower, (2) within the plant, (3) within the variety, and (4) within plants of the same cross. Attention has been paid to the consideration of the form of the young as compared with the fully grown parts in stem, leaf and fruit, noting the stages that the parts pass through in attaining maturity.

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*Began September 1st.

† Structure of Tomato Skins." Bulletin No. 228, pp. 20, plates 8, by Dr. B. H. A. Groth.

2. PLANT TOXICOLOGY.—The investigations with poisons have not, generally speaking, passed beyond the initial stage save in the case of that of the Bordeaux Mixture as influencing the health of peach leaves where results have been issued during the year in bulletin form.* An experiment with various plants involving forty-eight two-gallon crocks filled with sand and carrying pure chemicals in definite amounts, is now in progress. Many other potted plants are being treated with various substances, possibly poisonous to plants,—some of them being colored liquids as fuchsin and eosine,—from which, points in the movements of toxic liquids are in sight.

3. PLANT SAP CIRCULATION.—Somewhat closely related to the last subject is one that has been carried on with the sweet potato, a statement of the progress of which was made in the last annual report, and the conclusion of the same is given elsewhere in this volume.

4. PLANT SHADING.—A study has been begun of plants of several kinds in shade as compared with controls in the open greenhouse. In other words, a portion of the plants under glass were covered by a tent, thus furnishing controlled conditions for shade and for sun. Substantial progress under this head is shown elsewhere in this report.

EXPERIMENTS WITH CORN.

Owing to unusual pressure for land to meet the needs of other experiments, the size of the blocks was much reduced and unfortunately the prolonged drought came at the time when the ears were beginning to form and results for this season are in many instances very meager. There were twenty-four blocks, nine upon the Home Grounds and fifteen upon the North Lot and Strips; upon the latter the soil is still poor and the crop nearly failed.

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*"Contribution to the Study of Bordeaux Injury on Peaches," Bulletin No. 232, pp. 20, plates 2, by Dr. B. H. A. Groth.

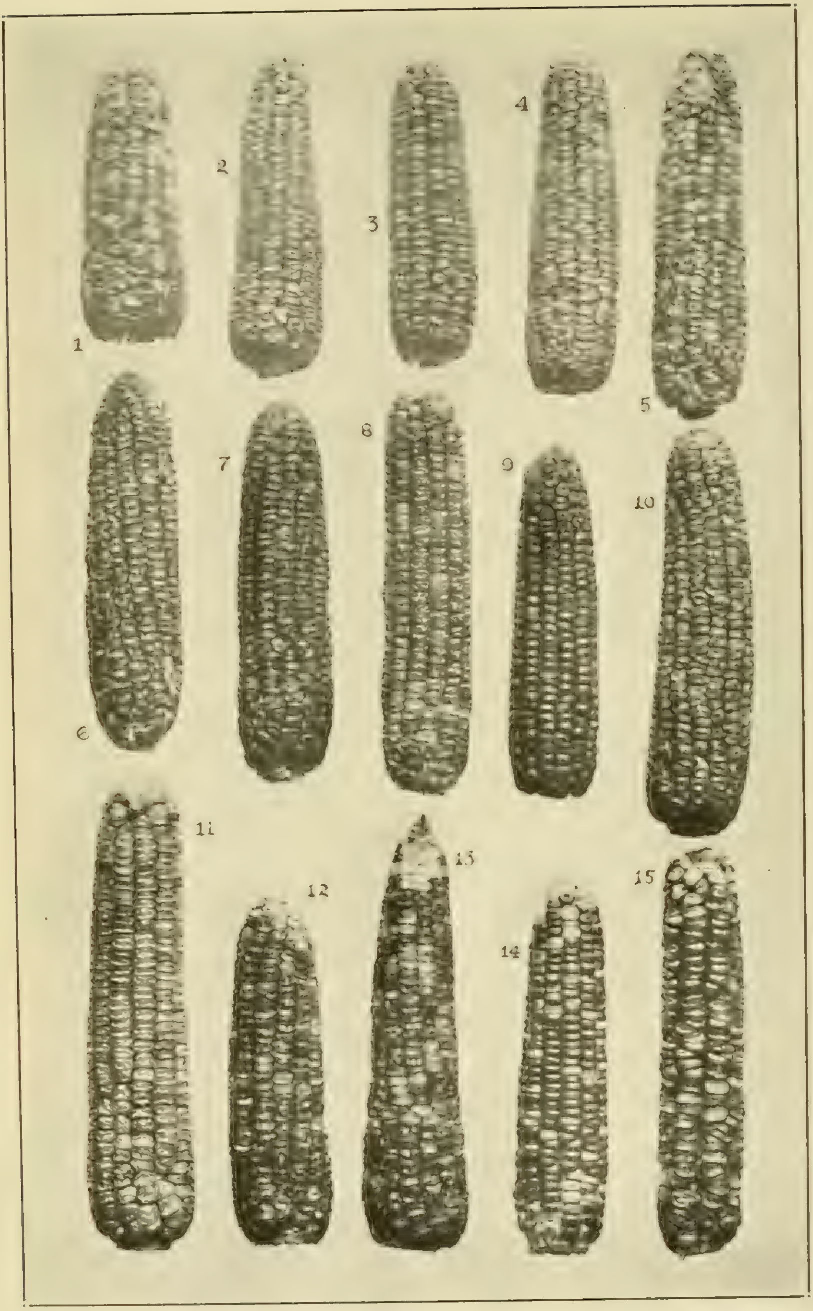
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PLATE I. *Crossed Sweet Corn.* Fifteen ears showing stages in the study of color inheritance (from a drought-dwarfed crop).

THE "VOORHEES RED-STOWELL'S EVERGREEN" CROSSES.

During 1910, two blocks of the above cross were grown, namely: (1) planted with pink grains and (2) dark red ("black") grains. The ears from the pink grains all had the same color with variations as to the depth of the shade, suggesting that the amount was an ear characteristic. Some of the ears showed a small percentage of white, thus indicating that there were some "hybrid" grains planted, but the ratio was much less than that demanded by the Mendelian rule because of the swamping effect of the great preponderance of pure pink parent plants. On the other hand, some of the ears had a small percentage of dark grains and, in rare instances, a white kernel. Two ears are shown at 1 and 2 in Plate I.*

The block planted with the "black" (dark red) grains had the ears generally very dark; some with no white kernels; while others showed a background of similar "black" grains in which was scattered a small percentage of white. In the solid dark ears that doubtless arise from a pure "black" grain, there was a small percentage of pink grains that seem to have resulted from the action of white pollen, for there was more or less of this recessive throughout the whole block. Three ears of this strain are shown at 3, 4, and 5, the latter with a few white grains.

THE "VOORHEES RED-EGYPTIAN" CROSS.

Similarly to the last, the cross between the "Voorhees" and "Egyptian" has been continued for another generation. The ears from the pink grain were pink, some of them solid with here and there a grain darker than the others, while other ears had a small per cent. of white as shown at 6 and 7, the latter being solid red. The block planted with "black" grains usually gave solid black ears or those with a few red or white grains (8). There was a strong tendency toward flintiness in some ears, as shown in No. 9.

THE "VOORHEES RED-GOLDEN BANTAM-BANANA" CROSS.

The above combination was grown only in the selected pink strain and all the ears were of a pale pink and usually solid, that is, without white grains, but the shade of pink varied greatly even upon the same ear. A specimen ear is shown at 10 in the plate.

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*Plates I-XXX were made from photographs by Mr. F. H. Dodge, and XXXI-XXXIII by Prof. M. H. Blake, to whom many thanks are due for painstaking skill.

THE "STOWELL-BLACK MEXICAN" CROSSES.

A block was planted with the cloudy grains of the above cross, that is, there were only slight indications of the black color. As a result of this, a set of quite uniform ears was obtained in which a majority of the grains appeared to be without color, a few were nearly full black, and the remainder carried more or less color. It remains to be seen just what may come from a continued selection of the cloudy grains for several generations. An ear of this strain is shown at 11.

The ears 12 and 13 are representatives from the cross of "Black Mexican" upon "Stowell's Evergreen," the whole crop showing quite uniformly the 75% black or some degree of color and 25% of white grains.

Plant variation was manifest in many ways that do not admit of representation by photography. As an example, some ears as at 14, showed a strong tendency to flintiness in which there were practically no sweet grains but all were more or less starchy whether white or dark.

In the same block were a few ears (15) that showed particularly the influence of pollen from a block of yellow field corn grown some distance away. Plants with those ears were ones that bloomed late and at the same time as the field crop. Here an indeterminate number of the grains are truly flinty; some of them yellow; and others a dull variable gray. These latter have both the black of the mother and the yellow of the pollinator, the former nearly disguising the latter. The flint grains may stand between those fully sweet and wrinkled and illustrating a type of seed character that is transferred by the pollen in distinction to that of flintiness that develops in sweet corn as an ear (or plant) character, as illustrated in the ears at 9 and 14.

FLINTINESS IN SWEET CORN.

The "Malamo" sweet corn has for years exhibited a strong tendency, in certain plants, to become flinty, and last year it was shown that many ears from selected flinty grain grown by themselves produced a large percentage of nearly solid flinty grains.

During the present season, three isolated blocks of "Malamo" were planted, namely, (1) with typical sweet grains; (2) with flinty grains from a nearly flinty ear; and (3) a block with three rows of the first and two alternating rows of the second from the same packets as above respectively. Unfortunately the conditions were made more favorable for the last block as it was practically saved from ruin by timely irrigation, and this ac-

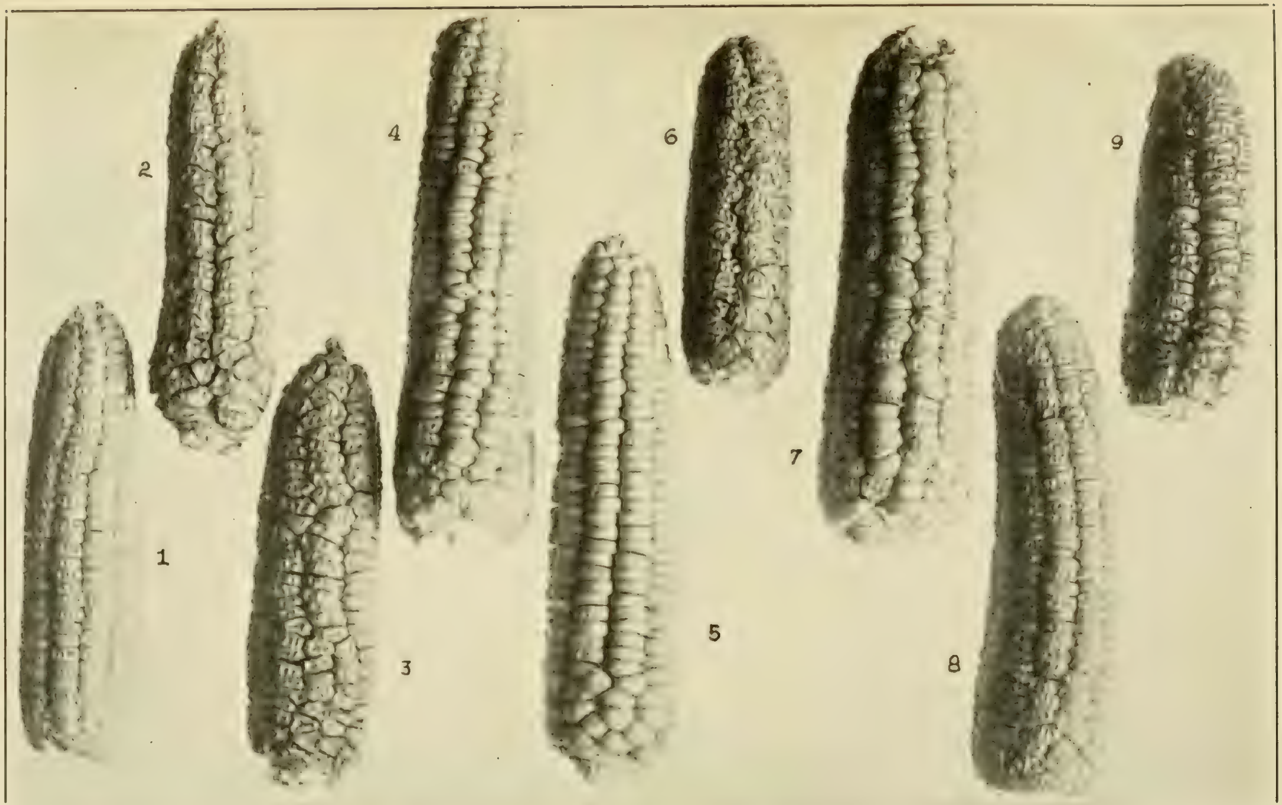

PLATE II. *Sweet Corn.* Ears of "Malamo" showing flintiness strongly developed in ears 4 and 5, and none in 2, 3, 6 and 9.

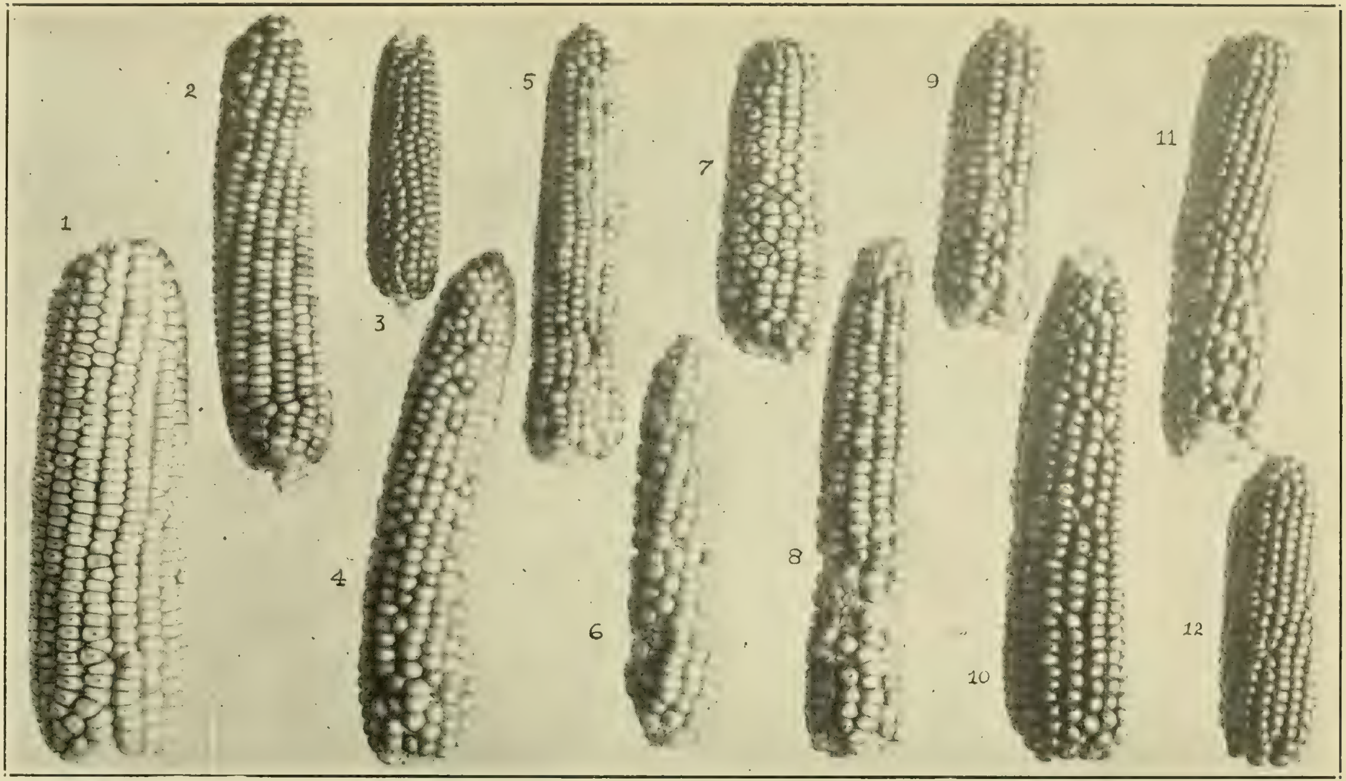

Plate III. *Crossed Corn.* "Field White Dent" (at 1) upon "Dwarf Yellow Pop" (2) is shown at 3. The ears from 4 to 12 are offspring of 2 and selected for variations in shape, size and color.

counts for some wide differences in size that appear in Plate II. At 1 is shown a sample ear grown in the first block and has more or less starch in the grains, many of them being nearly smooth. The ear at 2 is from the block of sweet "Malamo" and shows no signs of starch in the exceedingly wrinkled grains. No. 3 is a corresponding ear grown from seed from the same packet as the last, as were also ears 6 and 9, all of which are quite alike in general appearance and to the present purpose show no flintiness. The ears 4 and 5 are samples from one row that was planted from the same packet as the block that produced ear 1 by isolation. In like manner, ears 7 and 8 represent the second flinty row. One of the most striking features of the test is the much larger size of the ears grown from the flinty seed which may be explained by their parentage being possibly of a stronger strain from which the ears have been selected for the past two years. The four large ears all show marked differences that might be the starting-points for sub-strains among these flinty sorts; thus ear 5 is quite unlike ear 8, particularly in the amount and disposition of the starch.

The chief point of the present test is that, presuming that there was free interchange of pollen, there should be no more indication of starch formation (flintiness) in the ears grown alongside of the flinty-eared plants than in the block that had only its own strain for pollination. In other words, there was no suggestion from this test that anything like the immediate effect expected of starchy-grained corns upon sweet sorts obtains when the flintiness is of the sort under consideration. A continuation of the test, using the grains of the sweet ears produced close to the flinty ears this year may throw light upon a difference in breeding power between the two kinds of flintiness (or starchiness) in question.

SECOND GENERATION OF CROSS OF FIELD WHITE DENT UPON DWARF YELLOW POP.

Three blocks were planted from the same ear of the above cross of white field and yellow pop corns; (1) with white grains, (2) with lemon yellow, and (3) with orange grains respectively. The unusually poor conditions did not favor satisfactory results but it is evident that there is much less regularity of form, size, etc., of ears in the second than the first generation. In order to show this, Plate III has one of the ears of the first generation at 2 along with the two parents, "White Dent" at 1 and "Yellow Pop" at 3, while to the right are three samples from each block of the second generation. It is seen that the three white ears are all quite distinct, the one at 4 being the most like the male grandparent but showing no dent in the grains; the ear at 5 is quite like the grandmother in its shape and that of the grain. The ear at 6 resembles both grandparents, that is, is like the cross at 2.

In the second set of three, the lemon yellow color prevails with a considerable white, showing that the mother seed represented "hybrids." One of the three ears (7) shows very strongly the dent characteristic of the grandfather and the same is true of the shape of the ear although very much reduced in size. The next (8) is a long slender ear, quite out of proportion to either grandparents. It also shows a slight tendency towards the dent type of the grain, while the third ear (9) has the same form and size as the first but the grains are of the pop type.

The third group is chiefly with orange grains with an occasional kernel of lemon yellow. The first ear is broad at the butt like the grandfather, but the ear tapers into a tip that is more suggestive of the grandmother; all in all, this with its slightly dented grains is more like the field parent than the other two; and the third one (12), a solid orange, quite suggests a much broadened dent pop ear. The middle one (11) naturally finds its place between the other two—a homely spiral-rowed ear with nine per cent. of the grains lemon yellow.

An unexpected occurrence was that of five fully wrinkled or sweet grains upon the first ear in the lemon yellow set (7), the one in which the field dent parentage was most strongly manifest, and there was no similar instance elsewhere in the whole crop. The mother grain may have carried the sweet blood as a recessive character and this would, under normal conditions, have given 25 per cent. of sweet grains but as all surrounding plants were without this character, the number of wrinkled grains was greatly reduced.

The crop, while a most indifferent one, indicates that one may be able to select the pure colored grains from the "hybrids," the orange in this case being the former and the lemon kernels the latter.

EXPERIMENTS WITH EGGPLANTS.

Series I with the exception of two small blocks of sweet corn was devoted entirely to eggplants (533 plants) of which a fair set of the leading commercial sorts (14 kinds) was grown in a portion of Plot 1; but the greater part of the fifth of an acre was

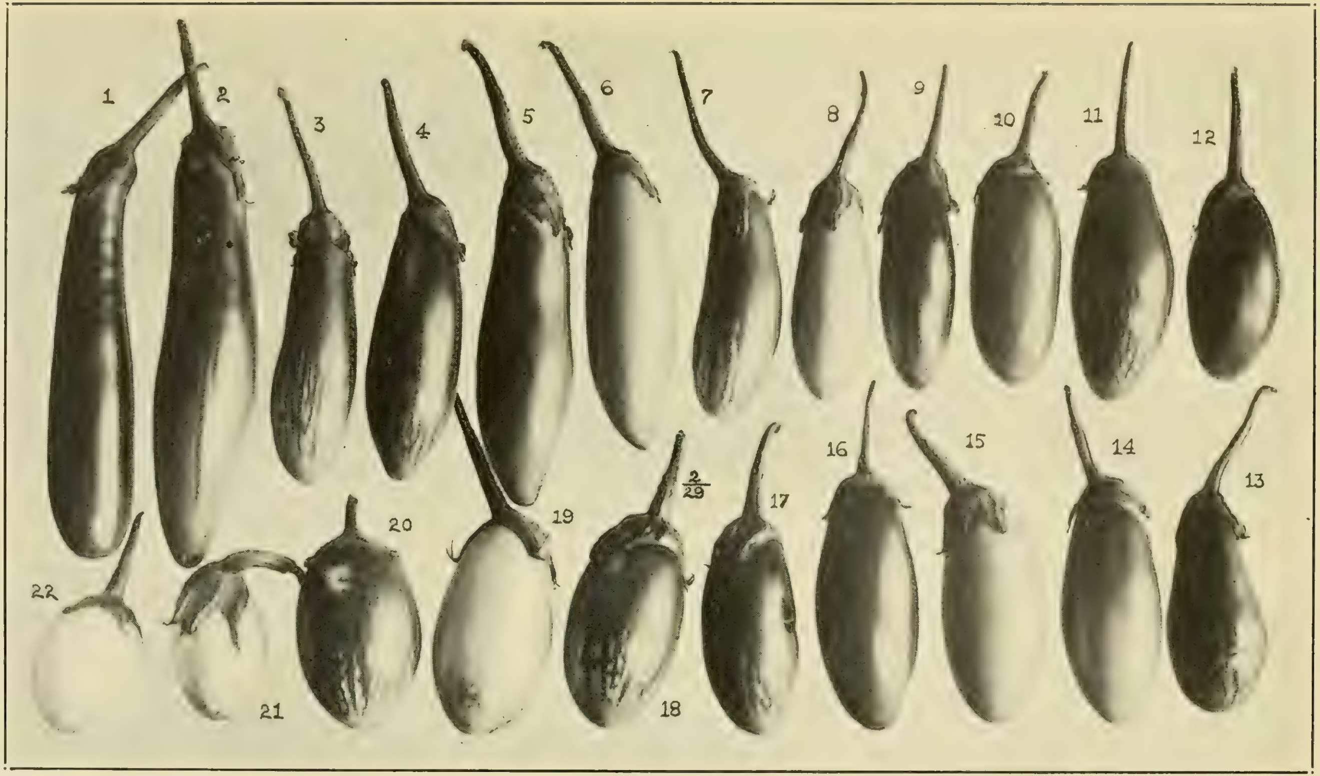
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PLATE IV. *Crossed Eggplants.* A series of half-grown fruits of "Black Snake" upon "Round White" is shown from 1 to 21, illustrating a fairly uniform intergrading of shapes.

occupied with crosses and hybrids (227 plants). Some of the crosses were grown in considerable numbers as, for example, that of "Black Snake" upon "Round White" (2/29); "Black Pekin" upon "Long White" (3/11); and "Long White" upon "Dwarf Purple" (11/6) being represented by 101, 127 and 23 plants respectively; while the blend hybrid of the "Scarlet Chinese" (25/19) had 44 plants.

The early portion of the season was unfavorable for the plants but with the coming of the rains in August and the withholding of the September frosts, a fair crop resulted.

"BLACK SNAKE" UPON "ROUND WHITE."

Plate IV shows a set of fruits representing 22 plants of the second generation (F 2) of the "Black Snake" (2) upon the "Round White" (29). The fruits were arranged upon the basis of form and, for photographic purposes, only partly grown specimens were employed but when thus near to half-size they have reached the general form of maturity. The series begins at 1 which is from a plant with fruits most nearly resembling the "Black Snake" parent. As the eye glances over the series, it is seen that the breadth increases slightly and the length decreases more rapidly until the specimen of the "Round White" parent is reached at 22.

A study of the fruits of 101 plants, representing this cross, does not reveal any grouping around parental forms or an intermediate that might be constructed mathematically between them. This is a case where the fruit of the cross sometimes exceeds that of either parent. The breeder may feel that the ratio of breadth to length, 5 to 7 cm., as fairly constant in the "Round White" when brought in vital touch with that of the "Black Snake," 4 to 20 cm. is enlarged in both its dimensions. In other words, the two factors of (1) breadth and (2) length do not act independently; that is, instead of an average of 4.5 by 13.5 cm. being approximated, an instance of the results is 6.5 by 9 cm., as shown at 20. A study of large numbers may bring some rule to light that is active in such unions of diverse forms.

When it comes to color, there is a more decided grouping under four heads. Thus of the 21 (No. 22, a parent being excluded) in the plate, selected without regard to color, it is found that the following scheme is represented:

Color.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total.
Purple	1			4	5				9			12				16	17					7
Pink		2								10				14								3
Green			3				7				11		13					18		20		6
White						6		8							15				19		21	5
																						21
Green beneath the calyx.	1	2	3	4			7		9		11		13			16½	17	18		20		11½
White beneath the calyx.					5	6		8		10		12		14	15	16½			19		21	9½
																						21

Purple	fruits	with	green	flesh.	No.	1, 4, 9, 16½, 17,	=4½	
Pink	“	“	“	“	“	2,	=1	
Green	“	“	“	“	“	3, 7, 11, 13, 18, 20,	=6	
White	“	“	“	“	“		=0	
								11½
Purple	“	“	white	“	“	5, 12, 16½	=2½	
Pink	“	“	“	“	“	10, 14,	=2	
Green	“	“	“	“	“		=0	
White	“	“	“	“	“	6, 8, 15, 19, 21	=5	
								9½
Total							=	21

In one instance (16½) the flesh was intermediate between green and white.

“BLACK PEKIN” UPON “LONG WHITE.”—(3/11).

Plate V shows a set of 15 fruits of a cross, second generation of “Black Pekin” (3) upon “Long White” (11), a sample of the first shown at 1 and the second at 17, all the fruits being of near half mature size for convenience in making the group photograph. In this cross, the shapes and colors are reversed from the cross above considered, the long “Black Snake” of the former being replaced by the spherical “Pekin” and the “Long” is substituted for the “Round” in the white mother plant. The fifteen specimens, one from each plant, are arranged between the parents in a series regarding shape only and it seems clear here as above that if the list was greatly prolonged all the intergrades might be found between the spherical “Pekin” and the club-shaped “Long White.”

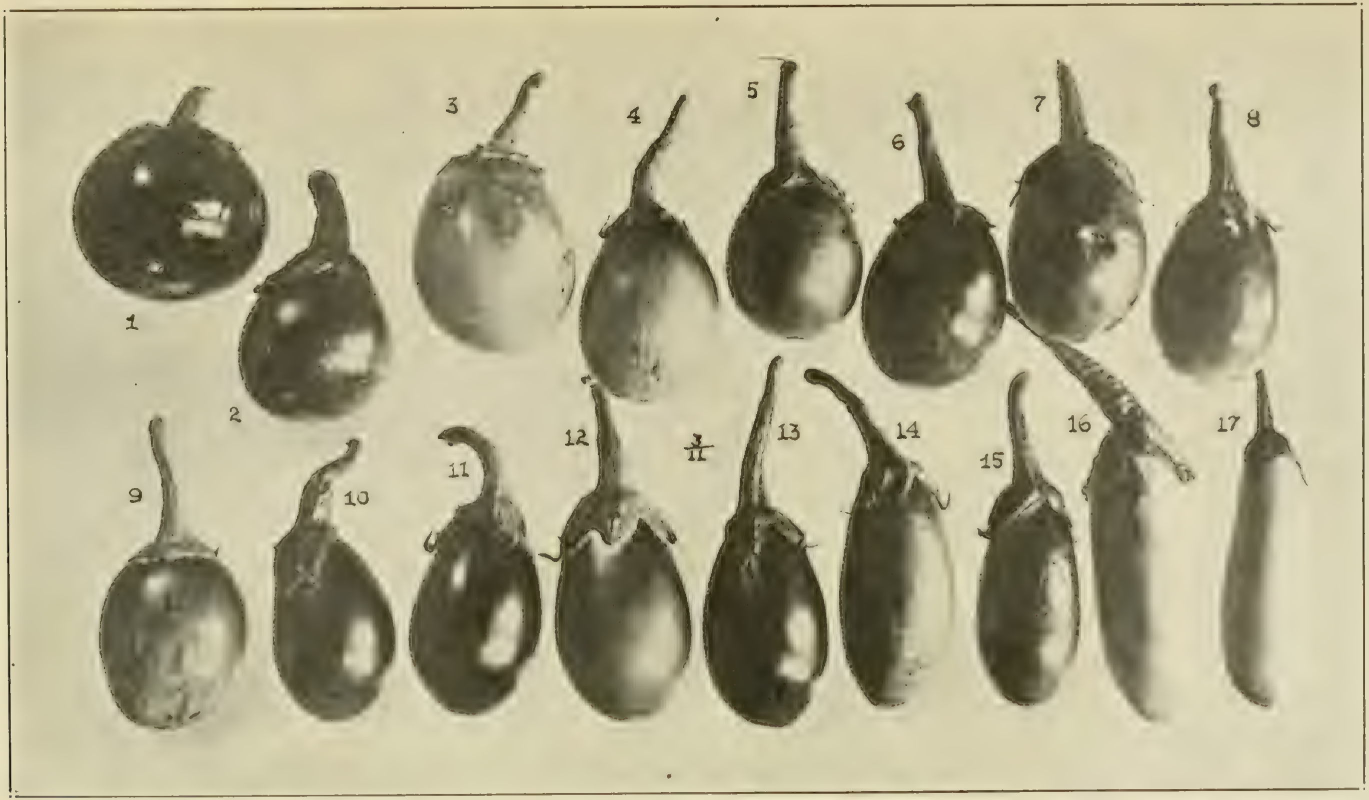
1
2
3
4
5
6
7
8
9
10
11
12
$\frac{3}{11}$
13
14
15
16
17

PLATE V. *Crossed Eggplants.* A series of half grown fruits of "Black Pekin" upon "Long White" is shown from 2 to 16, with the parents at 1 and 17, respectively, and illustrating a fairly uniform intergrading of shapes.

The schedule of color of the exteriors is as follows:

Purple	5
Pink with green beneath calyx	2
" " white " "	2
Green	4
Greenish white	2

There is no apparent correlation between the color and shape. There are only two specimens white beneath the calyx, that is, with the white flesh that characterizes the "Long White," and these are both pink and otherwise easily distinguished from the pinks with the green beneath the calyx and indicative of the lack of white flesh but instead pervaded with green, especially near the surface.

COLORS IN EGGPLANT FRUITS.

The commonly accepted color for eggplant fruits is purple and any other color is not yet popular. There are ranges in the shades of purple as the fruits are displayed in the market or at the vegetable shows. Thus the color of the "New York Improved" (19) is quite different from that of the "Black Pekin" (3), the latter having a darker and brighter shade not easily described. With the latter belong the "dwarf purples" and a few others as "Tokio."

The surface color of the "Pekin" seems to demand the sunlight for its full development as it may be retarded by bagging the fruit; or even the shade of the plant itself or a single leaf lying across the developing "egg" may occasion a striking contrast in the surface of the fruit. The large overlapping calyx in this type, when lifted, exposes no rich purple of the surface that it covered; and when cut away, the pink of the developing color soon appears.

In case of the less rich "velvety" color of the fruits of a group of varieties represented by the "New York Improved," the color is nearly as strongly developed under the calyx as elsewhere and the sunny side of the fruit is not strongly marked by the deeper color.

With these two shades of purple in mind, it is necessary to go deeper without discussing further the surface colors because of the marked influence of the flesh color upon that of the surface. As pointed out elsewhere, there are at least two shades of the flesh of eggplant fruits, namely, the white and the green with a third group which embraces a mixture of the two.

The white sorts, as "Round White" (2), "Long White" (29), and a number of others, including the "Ivory" (26) of our own make, are practically colorless from the time the corolla drops, that is, the interior of the fruit is white and the skin enclosing it is transparent. This condition of things continues through the market-maturity period when the white fruits are peculiarly attractive after which a pale lemon (cream) shade begins to appear, first upon the sun-exposed side and culminates in the light orange of maturity. In short, the, at first, colorless fruits develop a shade of orange limited to the outer layer that is common to all other kinds when the condition of ripeness is attained.

The green-fruited plants of common occurrence upon the breeding grounds, frequently have the "eggs" with very much of green just beneath the colorless skin and diminishing in amount toward the interior of the fruit save in the placentae which sometimes are strongly and distinctly green. Among this group, there are all degrees of striping and mottling, the blossom-end frequently being nearly free from the solid green that may obtain at the stem-end. This diversified marking is due to the smaller amount of the green lying close beneath the skin and the color of the lighter flesh shows through the transparent skin. The green fruits while young show as much green beneath the calyx as elsewhere and when of market size the color is only somewhat lighter. As the green fruits ripen, the orange color due to the change of the outer layer makes its appearance in place of the earlier green.

The "Striped" varieties, instanced in No. 21, have the flesh white and as the "egg" peeps from the large infolding calyx, it is often white for all its exterior but soon pale dark pink lines appear radiating from the blossom-end toward the stem. This coloring is at first limited to the outer cells and as the fruit reaches table-maturity, is scarcely more than skin deep but with the increase in amount, the surface becomes purplish. The calyx does not retard materially the development of the stripes upon the covered portion.

From the "Striped" it is only a short step to the group with white flesh that has the color quite evenly distributed as in U. S. D. A. No. 27666 from Russia and grown here for the first time. The white flesh is evenly covered with a purple layer which is quite easily peeled off and at the same time splits into an outer practically colorless skin and the under purple-bearing layer. Under the calyx, the fruit surface is pale purple faintly striate throughout, the exposed part being distinctly of a deeper purple. The under surface of the calyx partakes of the striate purple of the fruit surface to which it is applied.

Add to the above, the green flesh and one has the condition seen in several commercial sorts. As a rule, such fruits are of a darker, duller purple due to the influence of the greenish tissue lying just below the color-bearing superficial layer. In such, the sub-calyx portion is less distinct than in the last group but, as a rule, is more or less evident. Many of the fruits in this group show a very handsome mottling and striping due to the unequal distribution of the green in the flesh, thus producing the effect of a variegated green fruit covered with a uniform layer of purple, not dense enough to obliterate the flesh markings.

Another type of coloring mentioned at the outset, is a deep (sometimes spoken of as "velvety") purple when fully developed, and is located in a thin layer just beneath a transparent skin and in a large sense is a plant color appearing in the stem, leaf, calyx, corolla, etc., and most pronounced where the parts are unshaded. This group of fruits may be divided into: (1) those sorts that have a white flesh and therefore the sub-calyx portion is beautifully white in striking contrast with the purple of the exposed surface. Such fruits often show attractive bands of alternating greater and less coloring just below the margin of the calyx due in part to the unequal receding of this cover or rather the elongation of the fruit. (2) The second set of varieties under this group has the flesh green and when this is uniform, the fruit is quite evenly of a darker ("velvety") purple than in the first set, but if the green interior is strongly streaked there may an indistinct mottling of even a strongly colored fruit. These latter fruits show a clear green beneath the calyx in place of the white of the first set.

If the two kinds of superficial colorings follow the Mendelian rule, it leads to many complications in breeding. That this is the fact seems to be shown by the results. Thus there are fruits that show a color apparently a combination of the two, with one shade of purple under the calyx and another when exposed to the direct sunlight.

A further combination obtains when the "velvety" purple color, common to all sun-lit parts of the plant, is associated with the less purple kind that is apparently confined to the inner wall of the fruit and is quite independent of the bright sunlight. When this occurs with the white flesh, as in crosses of the "Jersey Pink" with "Dwarf Purple," the color is very attractive and beneath the calyx the fruit purple ("pink") is alone, but upon the other portions of the fruit, especially on the sunny side, the color is dark and suggests the richest velvet.

Should the combination be in green-fleshed fruits, the results differ from the last in the duller shades with a very obscure mottling or striping where the green is very unevenly distributed. A concrete case is the following:—The "Dwarf Purple" (6) is a kind with the dark color pervading all exposed portions of the plant—the fruit stalk, for example, being nearly as shiny purple as the surface of the fruit but beneath the purple calyx the fruit surface is a pale pea-green. On the other hand, the "New York Improved" (19) is a sort with but little other than green in the fruit, stem and calyx, or elsewhere, with the almost mahogany-colored fruit-surface extending under the calyx and here as elsewhere more or less indistinctly striped. The cross of these two (6/19) gives a fruit that is somewhat wine-colored, a greenish chocolate beneath the calyx and more or less indistinctly striped at the blossom-end.

In the case of the twelve plants of the cross of the "Long White" (11) upon "Dwarf Purple" (6), the color scheme is as follows:

Green flesh —9	Purple skin.........6	= Dull purple fruits; green under calyx.
	Colorless skin.........3	= Green fruits.
White flesh—3	Purple skin.........3	= Bright purple fruits; white under calyx.
	Colorless skin.........0	= White fruits.

There were eight plants of the derivative cross of "Jersey Pink" (28) upon "Black Pekin" (3) upon "Black Beauty" (4). The "Jersey Pink" carries the white flesh; the "Pekin," the plant purple; and the "Beauty," the fruit color. The following shows the classification of colors:

Green flesh—8	Purple skin.........6	= Dull purple fruits; green under calyx.
	Colorless skin.........2	= Green fruits.

Among this small number the white flesh type did not appear.

The four plants of "Jersey Pink" upon "Purple Tokio" (32) gave the following:

Green flesh—2	Pink under calyx—1	White flesh—2	Pink under calyx.... 1
	Green " " 1		White under calyx.....1

In the case of a complex combination of "Ivory," "Black Snake," "Dwarf Purple," "Jersey Belle," and "Jersey Pink," all

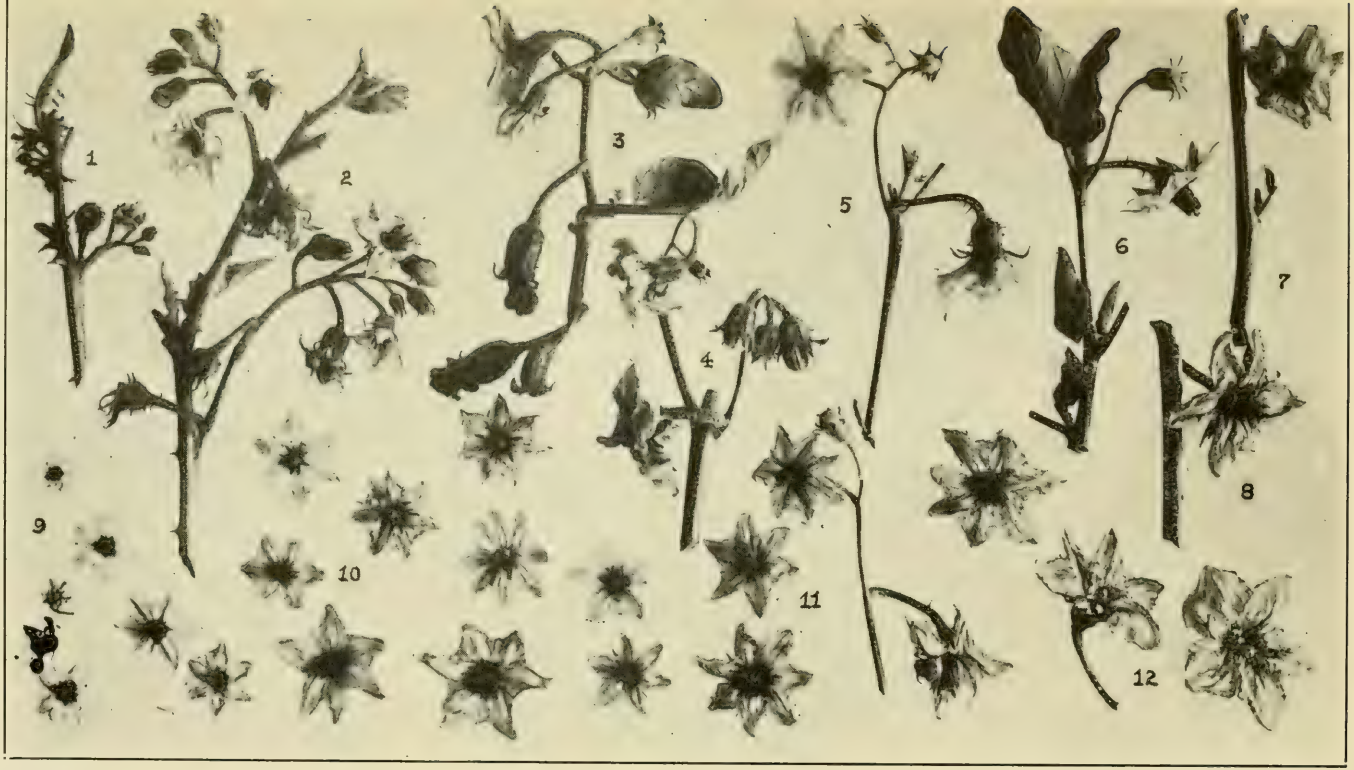

PLATE VI. *Crossed Eggplants.* Flower clusters of eggplants are shown in the upper half, varying in blooms from one to nine; the large prickly lower one usually being fruitful. Blossoms with a wide range of petal-lobes, etc., are shown in the lower half.

nine plants had green-fleshed fruits with purple color, wonderfully various—seven colored and two pea-green under the calyx. Very large numbers are essential for workable results in derivative crosses like this.

THE EGGPLANT INFLORESCENCE.

The inflorescence of the eggplant seems to be the extension of the main axis of the stem. There is a young stem with its various parts located between the flower cluster and the leaf (already quite large) that is at or near the same height upon the stem. The cluster may consist of from one to five (usually 2-4) flowers in the American sorts (*Solanum melongena*) and from five to twelve (usually 7-9) in the oriental species (*Solanum integrifolium*). The oldest flower is usually the largest in the cluster, arising near the base of the inflorescence and having a stout prickly peduncle that extends laterally and carries the blossom with its face downward. As a rule, the other one or more smaller flowers are upon slender stems and while frequently upright, seldom remain for long and possibly serve in fertilization like staminate flowers, strictly so-called, and drop by means of well-defined suture close above the first flower, which by this time has begun to develop its fruit, for the holding of which a stout descending stem is in evidence.

A second flower in the cluster may form a fruit as pairs at the same node show, but with the ordinary American sorts the first flower, as a rule, is the only one that produces a fruit. In the "Scarlet Chinese" the inflorescence bears more flowers, but there is a basal flower, that is somewhat lateral and with its stem and calyx much more prickly than the others. This, as a rule, forms a fruit and along with it, two or more of the blossoms next above. The time of blooming of a cluster extends over a week or ten days and by the time the upper flowers are open, those lower down are showing sizable green fruits. The uppermost flowers rarely, if ever, form fruits, and their pollen may be of service upon blossoms lower down or upon neighboring later flowers. In general, the cluster of the "American" is easily distinguished from that of the "Chinese" by the smaller number of blossoms and the usual limitation of the fruits to the oldest (axillary) flower.

At 2 in Plate VI is shown a spray of the hybrid in question with two inflorescences as appearing at blooming time. In the older, lower cluster the axillary flower is past and the spiny calyx is enclosing the forming fruit; the fifth and sixth flowers are fully out and those below probably would have dropped off excepting the lowest upon the side axis which has bent down as is the habit of the fruitful peduncles with a calyx bearing prickles. The upper inflorescence shows the axillary flower and the first two blossoms upon the side branch fully open. The Chinese parent is shown at 1, and it is noted that the inflorescense is a miniature of the ones above considered in the hybrid. In the American sorts shown in several specimens to the right, 3-7, the most noticeable features are the larger size and the fewer number of the blossoms. The usual inflorescence is perhaps best seen at 5, where the axillary blossom is with its face downward and the peduncle horizontal and much stouter than the rachis of the inflorescence and quite "spinose" while the latter is nearly free from prickles. The second flower shown full face view is in every way smaller than the axillary one and usually soon falls away as do the others as well as the rachis leaving the single fruit at the node. Practically the same general type of inflorescence is shown at 4. At 6 is shown an instance of two flowers only in a cluster, the one much larger, stouter stemmed, and more prickly than the other and produces a fruit. At 7 and 8 are to be seen the large horizontal flowers borne singly, that is, the temporary portions of the inflorescence have been omitted.

THE EGGPLANT FLOWER.

The fruit-producing flower of the eggplant is interestingly "spinose" (prickly), as stated above, and needs to be handled with gloves. A plant may be the "spineless" sort, so often mentioned in the seed catalogues, up to the time when its first flowers form when the calyx shows a set of formidable prickles. This calyx seems a direct continuation of the stem and has its thick leathery lobes surrounding the other parts until the large wheel-shaped purplish corolla unfolds bearing the stamens and surrounding the stout green-tipped style.

The parts of the floral organs vary from five in the small-fruited kinds to eight in the most highly developed or distorted by cultivation. In some of the former, as the "Black Snake," "Round White" and "Dwarf Purple," the flowers are comparatively small and the lobes of the corolla range from five to six, more or less. The corolla, the portion most easily studied, is a fair index of the other parts; that is, for example, when it is five-lobed the alternating stamens are of the same number and the fruit is apt to be smooth, while the contrariwise is true when the corolla is with eight or more lobes, the stamens are correspondingly increased and the fruit, even in the flower, shows

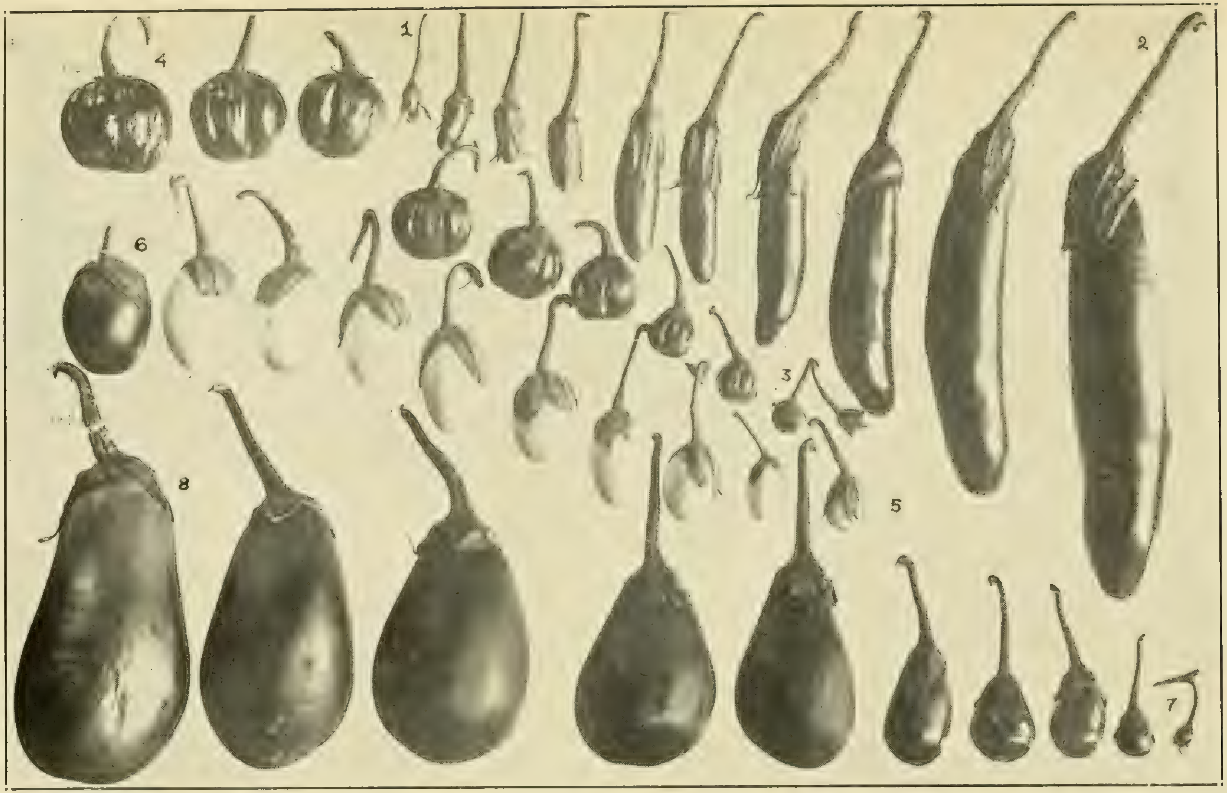

PLATE VII. *Crossed Eggplants.* Four series of Eggplant fruits are shown from "blossom stage" 1, 3, 5 and 7, to full grown fruits 2, 4, 6 and 8, respectively.

irregularities and the style may be strongly flattened, suggesting that the fruit may be corrugated or broad bell-shaped.

The lower portion of the plate deals with the single blossoms, those to the left (9) being of the Chinese species, followed by those of the hybrid (10), and to their right (11) are several of the American kinds. The corolla is often with five lobes in the smaller fruited kinds bearing alternating stamens; but six points to the "star" are the rule in some sorts, while seven and eight lobes are not uncommon especially among the large-fruited varieties, the fruits of which become broad and somewhat flat. Occasionally the tendency to become doubled is quite manifest as seen in the last two flowers (12) where the upper portion of each stamen has become petal-like even to the purple color characteristic of the dark-fruited sort in question.

UPON CHANGE IN FORM OF GROWING FRUITS.

In this study, ten fruits were taken from the same plant that formed a series from the time when the corolla and stamens were falling, until the fruit was of market (or mature) size. Additionally, measurements were taken of the stem (peduncle) and the adhering calyx.

Four kinds of widely different eggplants are shown in Plate VII. It is seen that the cross, "Black Snake" upon "Round White," had very generally the longest stems and the "Chameleon," the shortest. It is also shown that the peduncle was a subject of elongation, the "Dwarf Purple" extending from 23 to 63 mm. The "White Egg" showed remarkable variation, all of which obtains upon the same plant. (The stem of the mature fruit shown at the left end of the series was broken and the record is necessarily incomplete.)

A composite of the forty fruits made up for the four series indicates that the length is practically doubled (32 to 64 mm.) and the increase is probably quite uniform from the blossom to the ripe condition. The calyx of the same set in the composite increases from 22 to 39 mm. in length, and is probably uniform in the development of any particular fruit. The "Chameleon" is quite different from the three American sets in not showing any steady increase in size of calyx.

In length of fruit, there is a great range of variation among the four sets: the "White Egg" somewhat more than doubled its length; the "Chameleon" trebled its length; the "Dwarf Purple" started at 2.5 mm. and went to 132 mm.; while the "Black Snake-Round White" went from 10 to 205 mm. The composite shows an almost uniform series from 12 to 109 mm.

In breadth of fruit, the range was much less; beginning between 5 and 20 mm. and expanding to 40-87 mm. The "White Egg" doubled its width; the "Chameleon" broadened five times; the "Black Snake-Round White," eight times; while the "Dwarf Purple" showed the extreme limits of 5 to 87 mm. The composite shows a fairly steady increase through the different ages of fruits from 10 to 55 mm.

The four composites show an increase from flower to mature fruit as follows:

Peduncle	32 – 63	mm.
Calyx	22 – 38	"
Fruit length	12 –108	"
Fruit breadth	10 – 55	"

The greatest changes are (1) in length and (2) in breadth of fruit; next in length of stem; and least in expansion of calyx.

Taking the "Snake-R.White" and the "Chameleon" as representatives, the four points under consideration show contrasts as follows:

	"Snake-R.White."		"Chameleon."	
Peduncle	38 – 80	mm.	26.5 – 47	mm
Calyx	25 – 55	"	12 – 21	"
Fruit length	10 –205	"	11 – 42	"
Fruit breadth	5 – 44	"	10 – 50	"

The "Snake" starts out with a longer peduncle and broader calyx than the "Chameleon," while the length of fruit is practically the same and the breadth less by half. The peduncle and calyx grow greatly in the "Snake" and the length enormously, while the breadth is nearly the same in both at maturity, giving the long slender fruit in the "Snake" and the oval in the "Chameleon."

HYBRID EGGPLANTS. SEEDLESSNESS.

Plate VIII shows, in its upper portion, a few fruits of the blend of the "Chinese" (25) upon the "American" ("New York Improved," 19). The plants were very remarkable for their vigor and numerous blossoms. In the early part of the season but few flowers set fruits but later clusters of three and more small fruits formed. The earlier fruits (1) resembled quite closely the "Chinese" parent in being flat, deeply corrugated and colored orange-red when mature (4). This matter of maturity is mentioned with some reservations for an examination of a con-

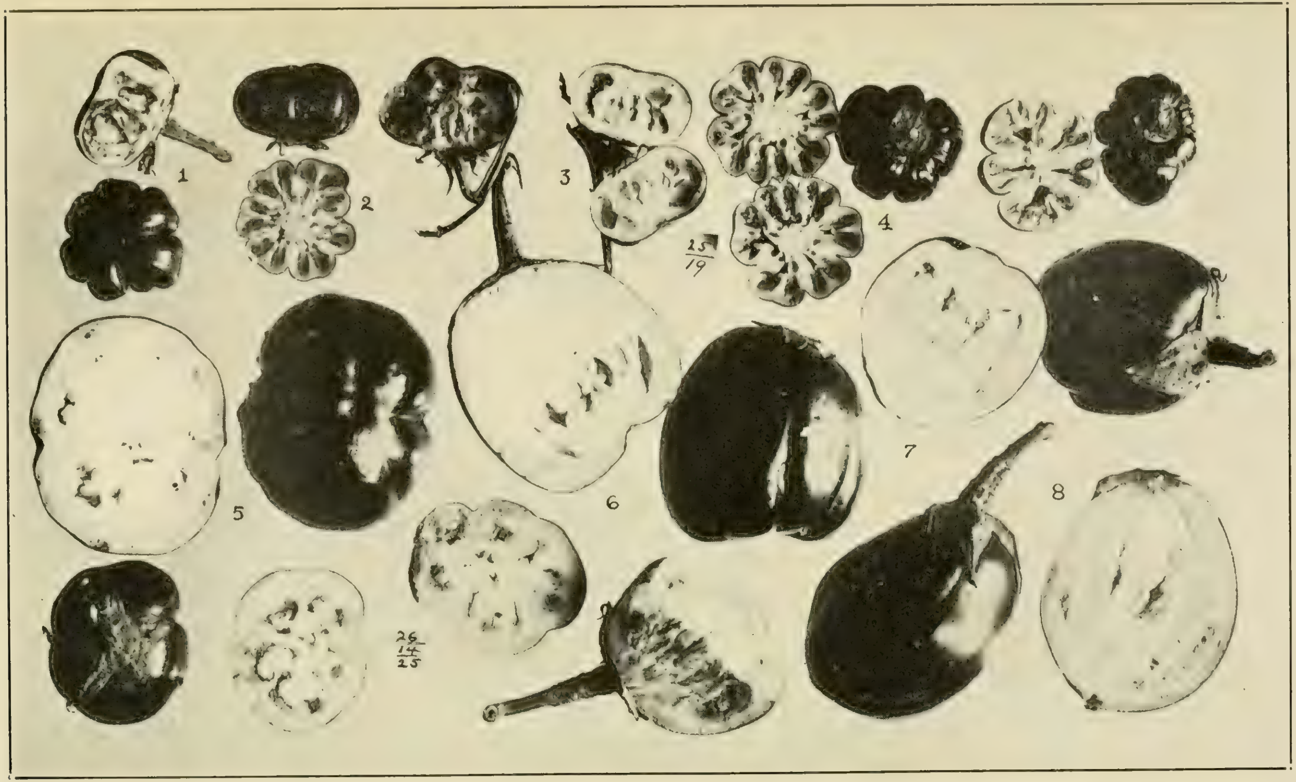

PLATE VIII. *Hybrid Eggplants.* The upper portion shows fruits (all seedless) of the first generation of "Chinese" upon "American." The larger fruits in the lower half are one-quarter "Chinese" and nearly seedless.

siderable number of the fruits revealed the fact that they were seedless. The apparently full-sized fruits average from 3 to 7 cm. and show 5 to 7 prominent ribs each having a V-shaped seed-cavity filled with a slightly greenish semi-fluid; these structures are shown in the sections in the plate, particularly in the transverse views.

The tendency to be seedless in a derivative hybrid is shown in the specimens that occupy the lower two-thirds (5-8) of the plate. This is the result of the union of the "Ivory" (26) upon a hybrid of "Fordhook" upon "Chinese" expressed by the formula, 26//14/25. These fruits are ten or more centimeters long and broad and upon the same plant varying from a nearly smooth oval to a broad, flattish, ribbed type, thus favoring strongly the "Chinese" parent.

Some of the fruits are entirely seedless and the placentae are frequently nearly obliterated, while in other parts of the same fruit there are sizable cavities, as may be seen at 5, 6, and 7. The outer portion of the flesh separates easily from that within upon the "plane" of the placentae, thus bringing to view any seeds that have been formed. Upon the surface thus exposed there is somewhat of the olive green "slime" so abundant in the "Chinese" parent and its direct hybrid above observed. This portion bears the characteristic bitter and needs to be eliminated in the production of a fruit that is acceptable for the table, and this can be done by re-combining this hybrid with the "American" parent—a task that has been accomplished in the hybrid in which the "Chinese" is reduced to one-sixteenth of the whole. The point here, however, is to make a record of the practical sterility of the present hybrid and the pronounced retention of the seedlessness in cases where the two species are represented in the ratio of one to three. All hybrids between the "Chinese" and the "American" have not been barren; few seeds, however, have been the rule and the process points to a substantial method of reducing seediness that with many vegetable fruits may be highly desirable.

The ¾th "American" hybrids (6//25/6) continued from last year held to their fine reputation for vigor and productiveness, averaging 15.3 fruits per plant. In size the fruits were larger than the "Dwarf Purple" and usually the keeping quality was enhanced.

HYBRID EGGPLANTS. THE 15/16TH COMBINATION.

Last year's report, with two plates (VI and VII) considered the production of hybrid "American-Chinese" eggplants that represented ⅞th of the "American" "blood." During 1910, eighteen plants were grown of hybrids having only $\frac{1}{16}$th of the "Chinese," that is $\frac{15}{16}$th "American." The following formula represents one of these combinations, namely, 26////32-///6//25/6. Tracing back from the first union, 25/6, that is, "Chinese" upon "Dwarf Purple," it is noted that the "Dwarf Purple" was bred to the hybrid, giving 6//25/6, that is ¾th "Dwarf Purple." To this derivative was bred as the pollinator, the "Purple Tokio," which gave 32///6/25/6, or ⅞th "American." To this ⅞th, the "Ivory," a pure "American," was bred, which, by the same method of determining the amount of each parental species, begot offspring carrying th of the "American" eggplant.

Sample fruits of this combination are shown in Plate IX where one familiar with the parentage can see traces of the results of the four combinations. No two plants of the block are alike in the various characteristics that make up the two species thus brought together. The comparatively few seeds located far down toward the blossom-end, as shown in the sectional view of a most seedy specimen (3), is a desirable feature, for in the longer fruits (4) it is possible to get small slices nearly or quite free from seeds.

There is not much hope of getting rid of the prickles by this union, but this end is quite possible along another line.

LEAVES OF HYBRID EGGPLANTS.

Plate X shows a set of leaves from young to full-sized of (1) "Scarlet Chinese," (2) "New York Improved," and (3) of a hybrid plant of the two. In the first, shown in the upper row (1-4), the leaves approach the 7-lobed form with the lobes pointed—quite in contrast with the round lobes of the "American" set at the bottom of the plate (8-10). The petiole and main veins are purple and beset with stout prickles while the surface of the blade is only slightly woolly. The "American" variety has a very woolly blade with the framework free from purple color and prickles.

Between the two sets of parental leaves is photographed (5-7) the set of the hybrid and the differences are not at first manifest to the eye, but there is an "averaging up" of the differing characteristics of the "American" and "Chinese" in that the lobes are moderately pointed, the stout prickles are small and limited to the mid-rib, while the purple is about half as pronounced as in the "Chinese" and the woolly covering is much less than in

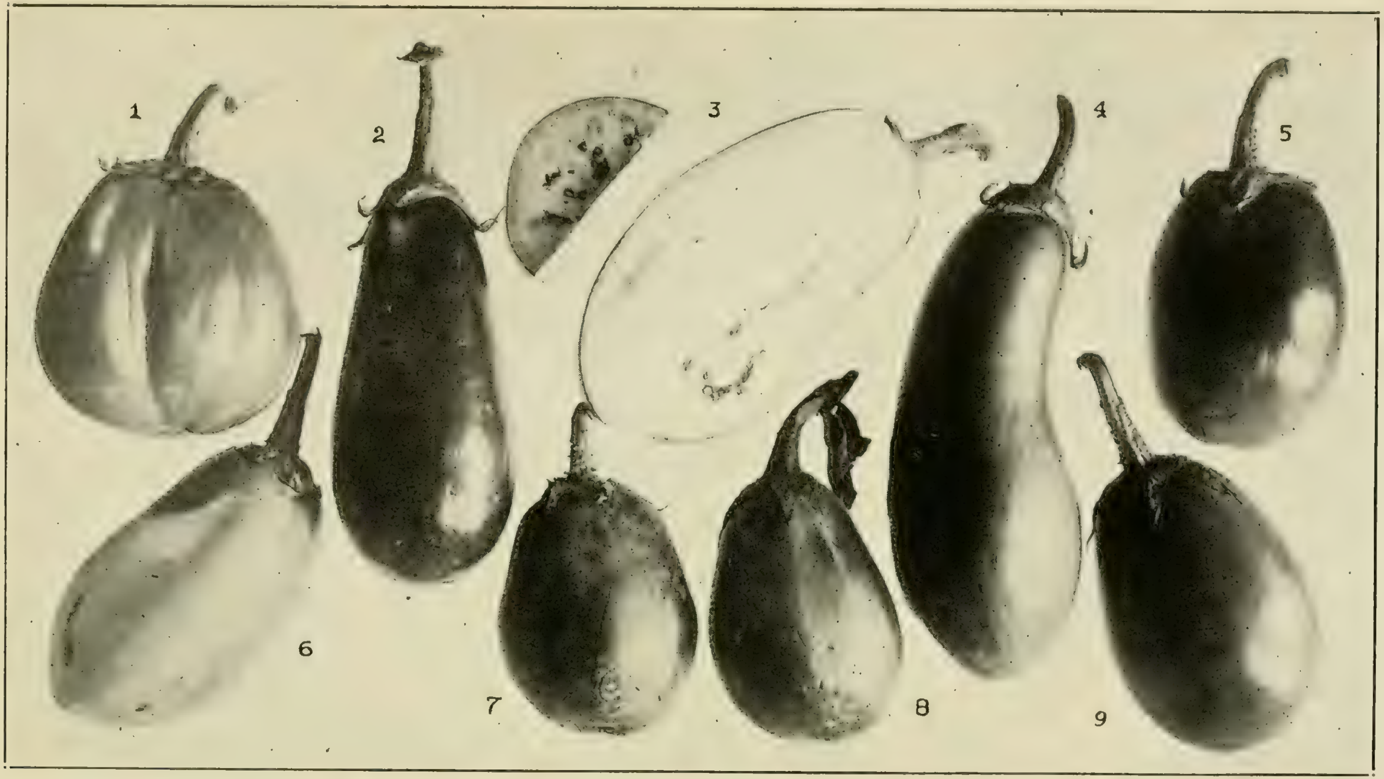

PLATE IX. *Hybrid Eggplants.* A fruit each from nine different plants of the combination of $\frac{1}{16}$th "Chinese $\frac{15}{16}$ths "American" are shown, of marketable size and good keeping quality.

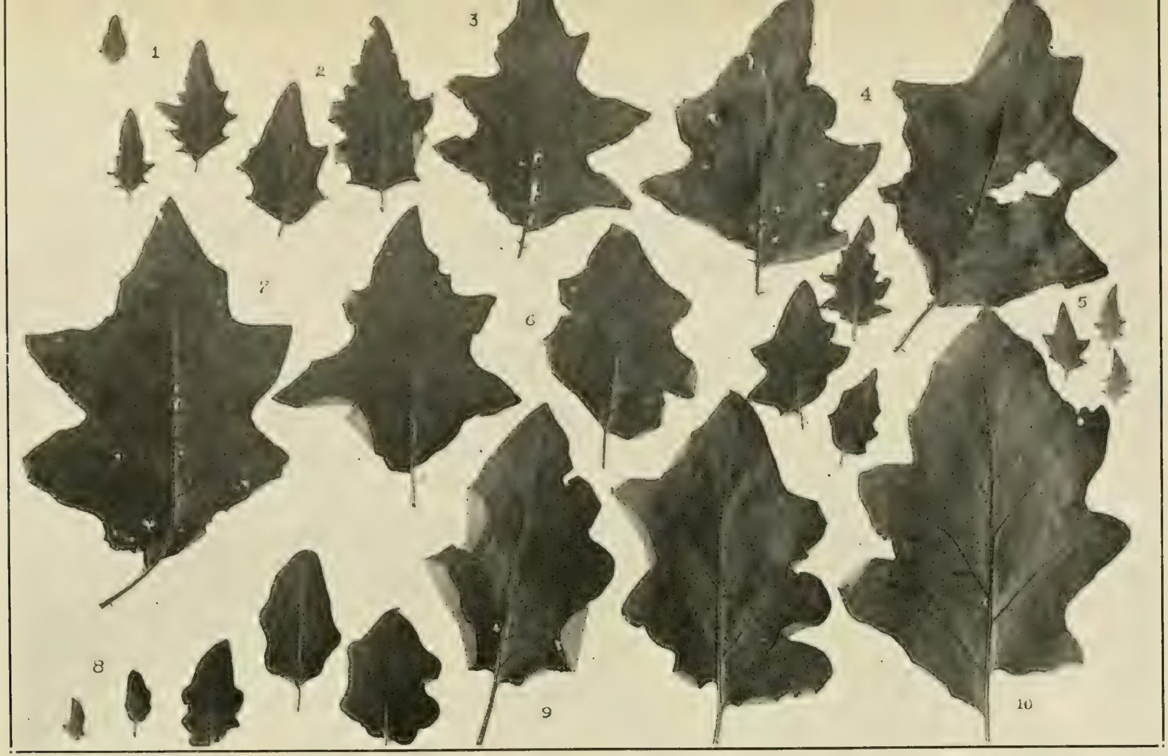

PLATE X. *Hybrid Eggplants.* A set of "Chinese" Eggplant leaves is shown from a young specimen at 1 to a mature one at 4; in the same manner for the "American" from 8 to 10, with a set for the hybrid 5 to 7 between.

the "American" parent. Plate X brings to the eye a portion of the plant, that is, an upper-face view of the foliage, that is least unlike in the two species, but even here a blending is very evident, particularly in texture, a feature that the camera does not easily catch.

EXPERIMENTS WITH PEPPERS.

The peppers occupied three plots of Series II and consisted of 35 commercial varieties and a large number of crosses chiefly in their second generation. The plants were all below the average in size due to the severe drought that prevailed at the time when the first blooms were beginning to appear. The season was somewhat prolonged by the nightly covering of selected plants for special study. Many crosses were secured but with peppers the flowers fall very badly when conditions for vigorous growth are interrupted and therefore it is quite evident that breeding with this crop can be carried forward more successfully under glass than in the open.

Some of the records, consisting of weights and counts of many thousands of fruits, etc., made upon the field crop, can not be brought into shape in the brief time which elapses from the harvest and the making of this report.

THE POSITION OF THE FRUITS OF PEPPERS.

Pepper fruits are quite easily divided into two groups, upon the position of the fruits, whether they are (1) upright or (2) pendent. There are a few varieties in which neither of these opposite positions are strictly adhered to and may be classed as intermediates. However, these last, when the mature fruits only are considered and particularly those first formed and therefore occupying positions in the angles of the main stems, are, as a rule, either pendent or upright.

The force of gravitation appears to have much to do with the position of the pepper fruits. In the varieties that have the fruits unquestionably upright, this position is maintained, as a rule, whether the stem bearing them is either perpendicular or horizontal or any angle between the two. The same is true of the pendent group, that is, the position of the stem has but little to do with that of the fruits.

To one who is only viewing the subject in a casual manner, it might seem that the above was quite otherwise, for one can see plants with their fruit pointing in any direction. This is probably due chiefly to the change in the position of the branches from the increasing weight of the fruits they are bearing. For example, a long branch with upright fruits may lean out many degrees from the perpendicular and at first the fruits will point towards the tip of the deflected stem and the older fruits with their woody stalks may remain nearly unchanged but the peduncles of the young fruits just emerging from the flower will attempt to adjust themselves to the new line of gravity.

Plate XI will help to illustrate this subject more clearly. At 15 is shown the normal upright position of the fruit in a cross, while at 16 is seen an upright branch of another plant of the same cross with the fruits pendent. At 1 is shown an upright spray of "Christmas" pepper and at 2 a horizontal branch from the same plant in which the fruits are actually more nearly upright than a photograph can show. In the small-fruited sort, "Bird's Eye" (4), at 3 and 4 are shown two sprays, the upright and the horizontal, with the fruits quite generally upon nearly perpendicular stems. Three tips of "Nocera Red" (79) at 5 and 6 illustrate the position taken by the young stout peduncles whether they are borne by perpendicular or by lateral branches, and the same is shown in a cross where both parents, "Oxheart" and "Chinese Giant," have pendent fruits. In "New Tomato" (48) and "Small Chili" (9), the subject is further illustrated and in the latter it is well shown that the perpendicular is assumed by the fruit-stalk quite early in the development of the fruit. These young stems seem as sensitive to the stimulus of gravitation as any other and they develop much supporting tissue particularly if the load of a large fruit is to be borne. Perhaps as striking an instance as any is given in the cross of the "Tomato" upon "Red Cherry," both upright, where the fruits long and curved are held aloft, whether the branch is upright as at 13, or lying upon the ground presumably from overweight as at 14. Upright branches, when purposely bent and fastened down to the horizontal, have been studied showing the general fact of conformity to gravity whether at the outset upright or pendent.

A study of the position of the pepper fruits naturally begins with the flower bud and as soon as it has any visible stem. Such stems are almost invariably upright, that is, parallel with the line of gravity which may be quite different from extending parallel with the branch that bears it. The young flowers or buds upon their peduncles are usually somewhat lateral, that is, bent so that the tip points more or less horizontally and the blossom opens with its face toward the horizon and not zenith-ward or its opposite.

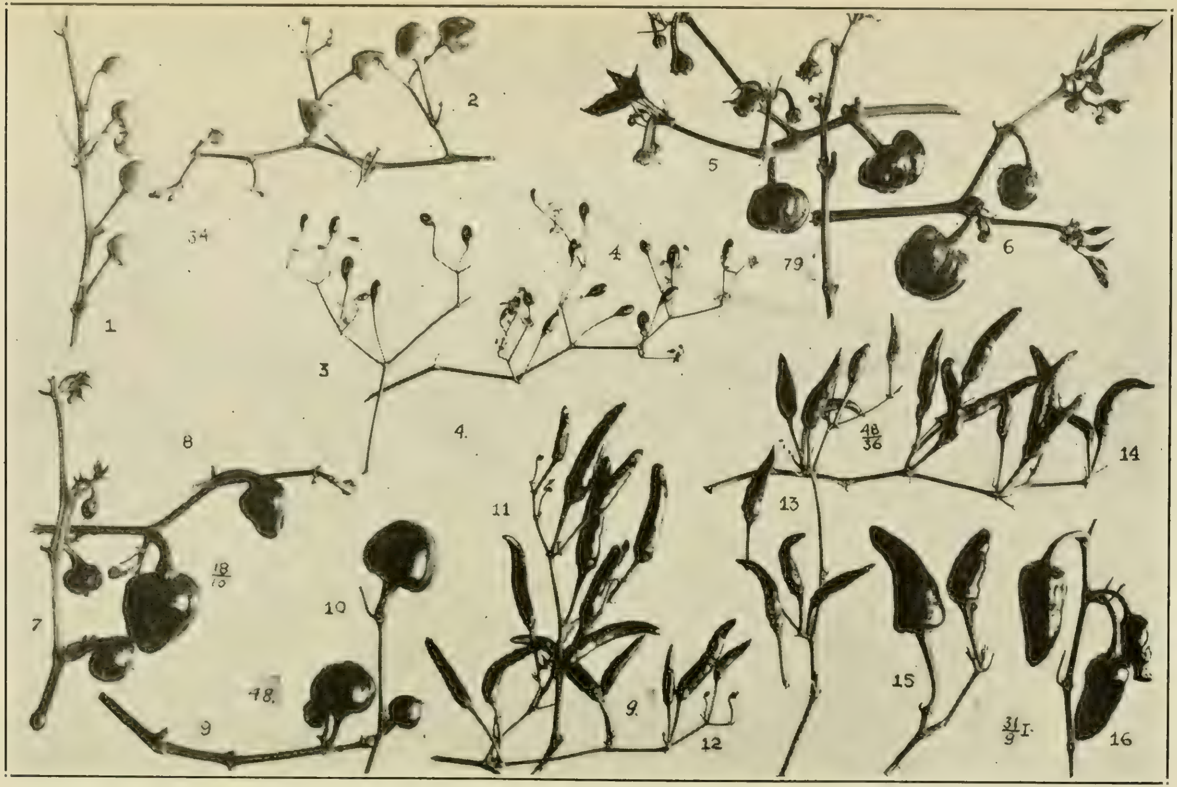
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Plate XI. *Pepper Fruits.* Seven groups of stems are given, showing the positions of the fruits as related to the line of gravity, for upright and horizontal branches of the same variety.

During the period of blooming, the flower-stalk elongates considerably, depending upon the variety, and by the time the corolla has fallen, it is usual to find the young fruit with its still adhering slender style pointed upward or downward as the variety is of the upright or pendent type. This final position seems to be reached by a growth taking place chiefly in the region of the peduncle just below the young fruit, the greater elongation upon the upper side turning the fruit down and contrariwise, when upon the under side, bringing the young pepper to an upright position. When once the vertical is reached, any change in the direction of the branch throwing the fruit upon it, out of plumb, will bring about a change in the peduncles so that the young fruit again resumes its vertical position. When the fruit is nearing full size, the above adjustment does not take place, due to a rigidity of the peduncle. Pepper branches are remarkably brittle and from winds and other causes the heavily laden stems are broken down and as they hang somewhat inverted, the fruits show the adjustment in whole or part that is above mentioned.

If one may be permitted to assume that the small-fruited sorts most nearly approach the wild condition of the *Capsicum annuum,* it seems probable that the pendent position is a characteristic that may have had its origin since the species (or group) has been under cultivation. At the present time, the pendent type outnumbers more than two to one those sorts with upright fruits. For example, of the fifty kinds listed in the report for 1908 (page 286), there are thirty-five pendent to fifteen upright. Of the former nineteen are large, while of the latter nine are small. In other words, the upright are generally small-fruited and the large-fruited are usually pendent. It is not, of course, merely a matter of size, for there are four quite large upright-fruited sorts in the above list and a like number with small pendent fruits. It is possible when the extremes of size only are considered the rule that the small are upright and the large, pendent, might be sustained.

As the position of the fruit is not clearly correlated with size, so it is not with that of shape; for the short and blunt, the long and slender, the round, and the large and angular may be either pendent or upright. The same is true of the various characteristics of stem and leaf, and including the matter of pungency in the fruit. In other words, the position of the fruit is no indication of "sweetness" or its opposite.

When it comes to the breeding of varieties together that differ in the position of the fruit, it is found that in the blend or first generation the fruits are pendent, but in the second generation the pendent characteristic is met with in three-fourths of the plants while the remaining quarter are upright or, in terms of Mendel, the pendent type is dominant and the upright recessive.

If the assumption be adhered to that the upright type is the ancient one, that is, of the wild parents of the various cultivated varieties, we have a case in which the younger, namely, the pendent type, is in control or dominates over the ancestors, giving only its kind in the generation immediately following the cross.

A study of the peduncles and particularly their union with the buds (flowers and fruits) shows that there is decided difference whether they bear pendent or upright fruits. As a rule, the latter have a more symmetrically developed peduncle (often shorter) than those that bear pendent fruits. While the upright type has the fruit borne upon a straight stem directly above the branch, the pendent's peduncle, although attached to the upper side of the branch, needs to bend outward and downward, so that the fruits gathered with their "stems on" show clearly to which type they belong, by the straight or curved peduncle.

PEPPER STEMS.

Pepper stems vary greatly among the varieties but are quite constant within any one commercial sort. There is more or less correlation between the character of the stem and the leaves and the fruit. Thus the slender-stemmed kinds, like "Bird's Eye," shown in Plate XII at 1, have small leaves and fruit. In such plants the internodes are long and with a secondary stem at each node; repeating this habit of the plant, the sprays become quite compound. Sometimes the two (or more) stems at a node are nearly of equal size, as shown at 2 (U. S. D. A. 22807), and the plant presents a repeated forking that results in a broad, flat-topped plant. Again, the branches are along one side of the main stem, as shown at 3 ("New Celestial"), from the axils of which the fruits arise somewhat in a row. Such stems are frequently inclined at forty-five degrees and may bear single fruits and one or two leaves of considerable size. In the cross, 48/36 I, that is, "New Tomato" (48) upon "Red Cranberry" (36) shown at 4 in the plate, there is a union of a tall ordinarily branched form of stem with a dwarf having the internodes very short and the leaves and fruits fascicled or grouped. For the sake of showing the stem, all the leaves have been removed, leaving the fruits only intact. It is with difficulty that the places of the many leaves can be seen but it

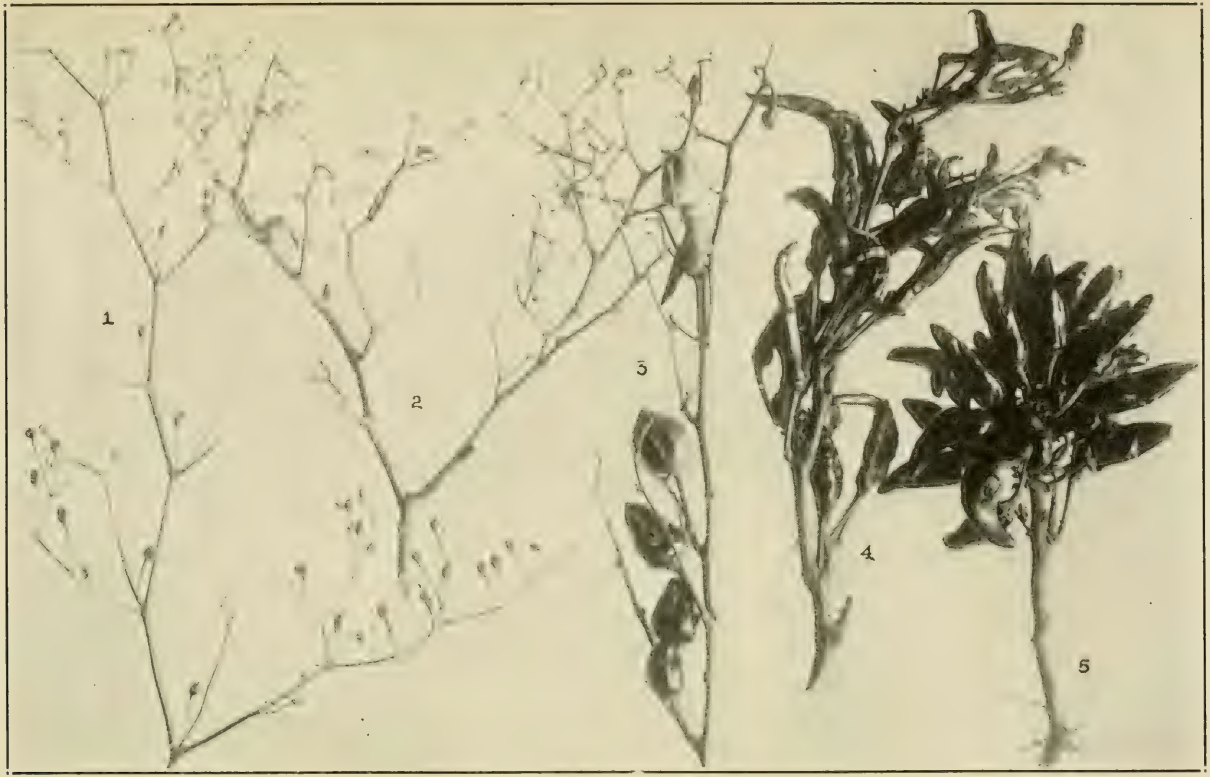

PLATE XII. *Pepper Stems.* A very slender type of a stem is shown at 1; one uniformly forked at 2, a "one-sided" type at 3; a long clustered form at 4; and the most condensed sort at 5.

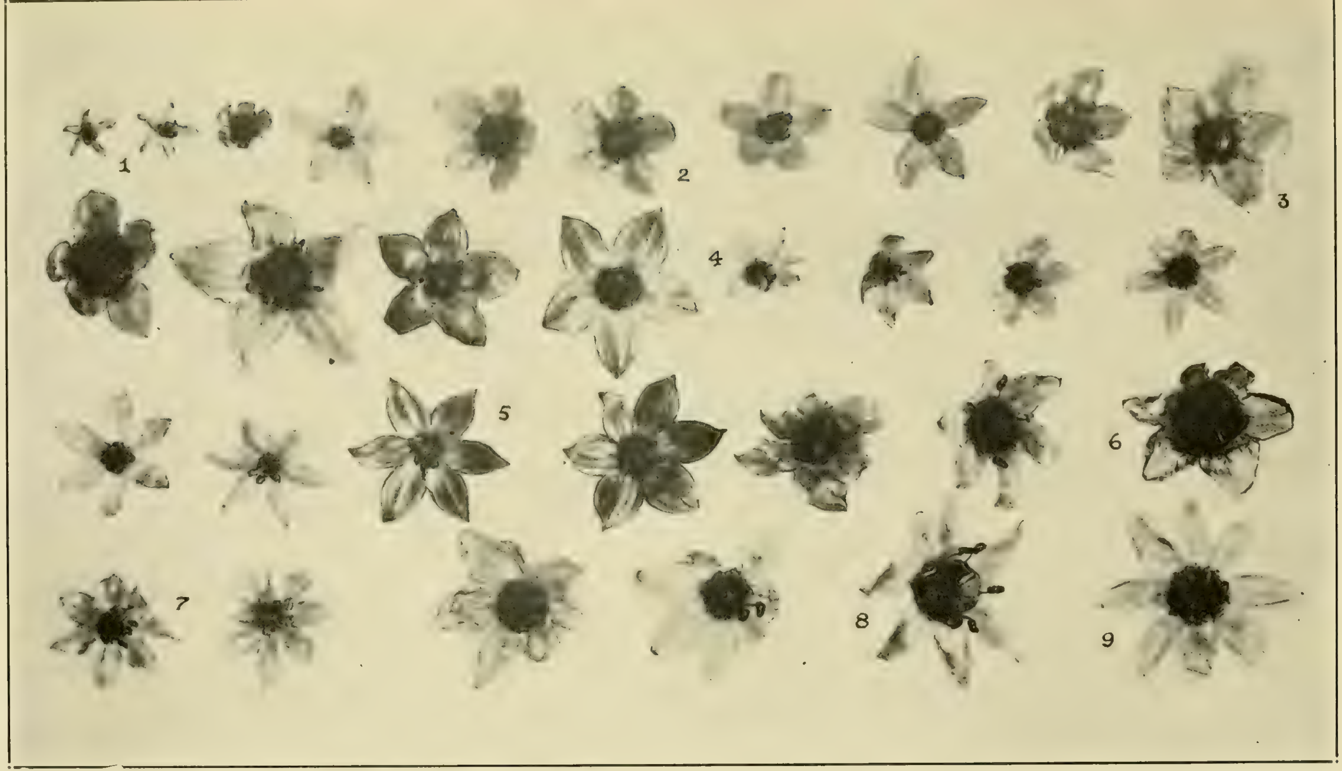

PLATE XIII. *Pepper Flowers.* The smaller and simpler kinds are shown at 1, and the complexity and size increase through the series to 9. The four around "5" were purple-colored specimens.

is easy to note the grouping of the fruit-bearing stems, quite in contrast with the singleness as shown in 1.

The extreme brevity in pepper stems is illustrated in 36/20 I, which is a cross of the last mentioned "Red Cranberry" (36) and the "Red Cherry" (20), in this case the plant adhering to the type of the dwarf-stemmed clustered-leaved parent. In this plant, shown at 5, the whole main stem was less than six inches long, while the quite sizable, much crowded fruits extended their tips upwards in all directions. Such plants could be grown in rows of several in a hill, like string beans. It is worthy of note that in breeding, the clustered form of leaf opposes the scattered type, some plants showing one or the other in the second generation.

PEPPER FLOWERS.

Plate XIII shows thirty-one flowers of peppers selected regardless of the variety because they vary considerably upon the same plant. Size of the flower and number of lobes of the corolla are the chief features of the engraving in question, the blooms being arranged with the face uppermost. At the upper left-hand corner (1) is shown a sample of the smallest of all the blooms grown. As a rule, the size of the blossom is a good index of the size of the fruit that is to follow; for example, the blossom at the opposite corner of the plate and particularly the one above it would have developed into a mammoth pepper sought for stuffing, etc.

As the eye glances along the first row (2-3), it will be observed that while the blossom increases in size, the number of lobes remains five, but their size and shape are very different. Near the middle (4) of the next row, the change is made from five to six lobes but the size is not correspondingly increased; in other words, the plate shows a long series (11 instances) of flowers of six lobes—perhaps the most general number among commercial peppers—ending with the third row (6). Those with seven lobes are shown in the first five flowers of the fourth row (7-8), which ends with a bloom (9) with the unusual number of eight lobes to the large showy corolla.

As a rule, the number of stamens agrees with that of the corolla lobes so that in the smaller flowers and presumably near to the wild type, the parts of the flower are as follows: calyx and corolla lobes, five each; stamens, five; and the pistil, one with two seed cavities.

The parts within the corolla are so dark that the photograph does not show them and only the relative size of the young fruit (pistil) can be determined. Occasionally the position of the stamens, alternating with the corolla lobes, can be seen. When the number of stamens and lobes do not agree, there are often clues as to how the "extra" one has been added.

The corolla is usually white but in a few kinds there is a dark color pervading the whole plant and in such, the corolla is of a beautiful purple. In the crosses of the white and such dark sorts, the color varies greatly, sometimes being colored in other parts and again only in stripes or limited to the margin. There are four such flowers in the plate shown around Figure 5.

A STUDY OF THE GROWTH OF THE PEPPER FRUIT.

Plate XIV shows sets of ten each, so far as possible, of twelve kinds of pepper fruits representing ten stages in their development. In this study three sets are included not represented in the engraving. A composite of each stage of the fruit indicates that the record began at 17 mm. and increased with a fair degree of regularity to the ninth stage where 28 mm. were reached from which it decreased one point to 27 mm. In like manner, the calyx length began at 4.25 mm., ascended to 5 in the middle (5th) stage, then fell below for three stages and finally reached the greatest length (5.25 mm.) in the matured fruit.

The fruit length of the composite began at 6.25 mm. and arose quite uniformly to 61 mm. when maturity was reached; measurements taken after this stage would show a decline due to the shrinkage which is unusually great, particularly in the long thin-walled fruits.

The increase in breadth is much less than in the length and the diagram shows an increase from 6 mm. to 29 mm. in a nearly uniform degree through all the stages of development.

This composite is made up of peppers of both the upright and pendent sorts and the long and short, the narrow and broad, so that an average does not express more than general facts. By taking the five upright and seven pendent types separately, it is determined that the former average shorter stems than the latter as the diagram herewith shows. The line for the upright stems begins with 14.5 mm. and extends in a quite variable line to 23.6 mm. while that representing the length of the stems of pendent fruits starts at 19.2 and extends also in a zig-zag manner to 31 mm. In other words, at all stages of the growth of the fruits, the upright has by 4 mm. a quite uniformly shorter stem than the pendent type.

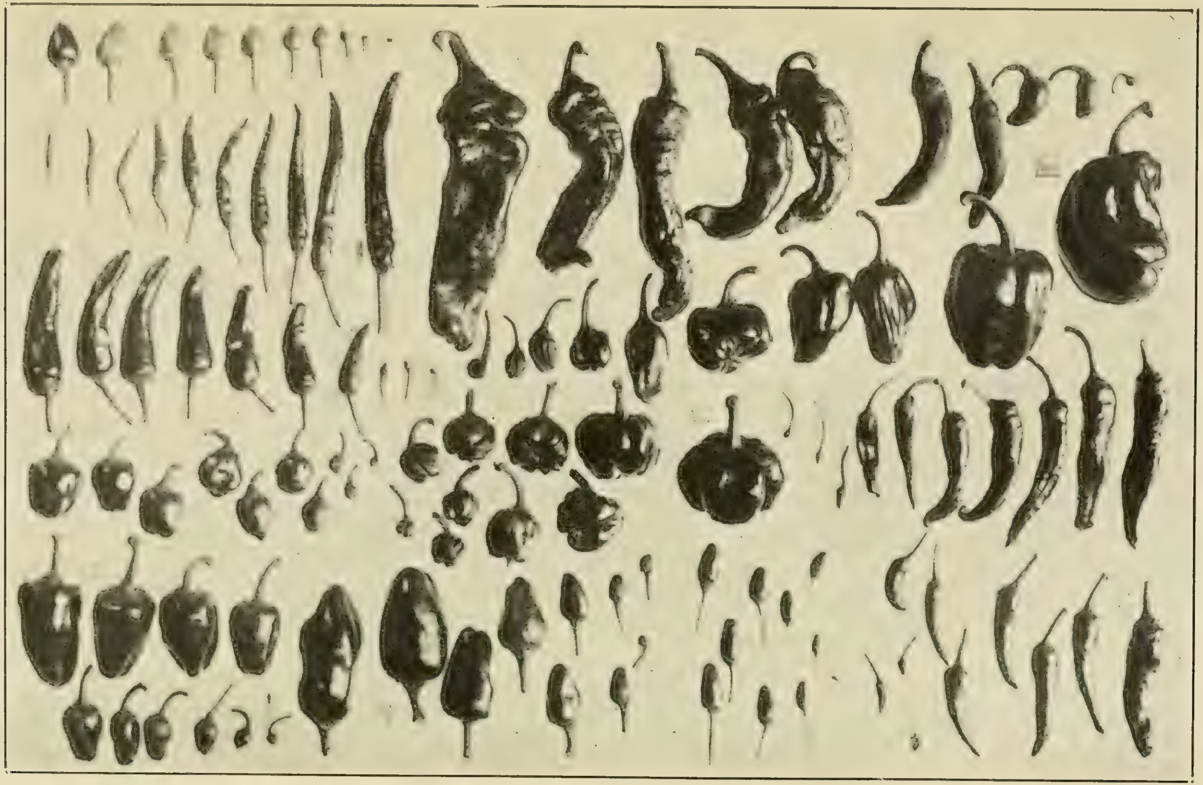

Plate XIV. *Pepper Fruits.* Sets of ten from "blossom stage" to maturity are shown for several sorts to illustrate somewhat the changes that take place in the development of the fruit.

In the large fruits it is clear that a longer stem is a practical accommodation in the turning down of the fruit but with the smaller fruits this is not so evident.

THE WALL OF PEPPER FRUITS.

By wall is understood that portion of the pepper fruit that surrounds and bears the placentae or seed-bearing part and in the oval-shaped fruits often forms a dome above the core and in the long slender sorts may bear the seeds upon usually two elongated placentae.

When young, just after the corolla and stamens have fallen, the wall is comparatively thin and fits closely upon the contents but with growth in size, its thickness increases until its maximum is reached at the time when the fruit is mature. After this there is a shrinking of the wall which is very evident to the eye in the collapse of the formerly firm cover and when dry is papery in thinness and texture.

The thickest of the free wall is at the apex in all pointed fruits, or the flat or even "dishing" end of the flat sorts like the "Tomato" and "Squash" peppers, or the rugose tip in the large "bullnose" type, now most familiar in the markets. In short, the thickest wall is at the blossom-end of the fruit when the style is long persistent and in many instances remains as a short point rising abruptly from the end of the ovary whether that be one or the other of the three types above mentioned, namely, (1) pointed, (2) smooth, or (3) rugose.

The wall is not of the same thickness in all other portions of the fruit. Thus a considerable series of measurements taken (1) at the base, (2) at the middle part, and (3) at the apex, show that the thickness is greater at the base than at the middle portion, that is, midway between the point where the wall joins the core (base) and the apex previously mentioned.

By the same method, it is determined that the wall of round types of peppers, as that of the "Cherry," "Tomato," and "Squash," is much thicker than in the long sorts. While the two types may start out from the bud with practically the same thickness, the former remains round and undergoes great thickening until at maturity the fruit is nearly smooth, firm, and heavy because no air space has been developed as found in the very long or large deeply grooved sorts. A study of the growth of the wall in the diverse types may show that the inflated kinds become so by a sort of stretching of the wall that would help to explain how the one is thick and the other comparatively thin. It goes without further saying that the very large fruited sorts are not solid nor with thick walls, while the kinds with the equatorial axis exceeding the polar and neither long are quite certain to have the wall thick—are, in other words, fleshy or solid.

In transection the pepper wall shows great diversity. In those with a circular outline, the wall is quite uniform with the placentae built upon it at two or more places and meeting at the center in the basal core or extending into the body cavity of the fruit above the core. In those fruits that soon become rugose (wrinkled) sometimes seen in the bud, there is quite a difference in the thickness of the wall, the infolds being the thinner parts, which in regular fruits alternate with the thicker ridges and bear probably a definite relation to the placental lines.

COLOR IN PEPPERS.

The color in peppers is quite variable; beginning with the seeds, they range from light to dark yellow, light to dark tan to red. The seedlings show only slight differences in the green of the cotyledons and first leaves; possibly there may be (1) a light and (2) a darker green line of separation of the varieties.

Considering only the upper side of the mature leaves, they vary, according to Prang's System, from green yellow green of Chart V (5 GYG) to yellow yellow green of Chart IV (4 YYG); in other words, the thirty-one commercial kinds examined were grouped as follows: 11, (5 GYG); 2, (6 GYG); 3, (5 YG); 12, (4 YG); and 3, (4 YYG). In other words, all ordinary pepper foliage shows yellow and in some instances this is more emphasized than the green.

There is a group of varieties represented by the "Black Nubian" that has much purple throughout the plant; in its various crosses, the shade of the green of the foliage falls into the first group above.

The stems of some kinds are entirely green while many show traces of a purple color that becomes quite pronounced at the nodes. In some of the "Nubian" crosses this dark color is either in narrow lines running lengthwise of the stem or pervades the whole surface layer of the stems and main veins of the leaves.

The corolla is white or greenish white in the ordinary sorts but in the "Nubian" crosses, it shows more or less of the purple prevalent in all parts of the plant. Generally, the other parts of the flower observe the rule of the stems and may be entirely green or show the purple.

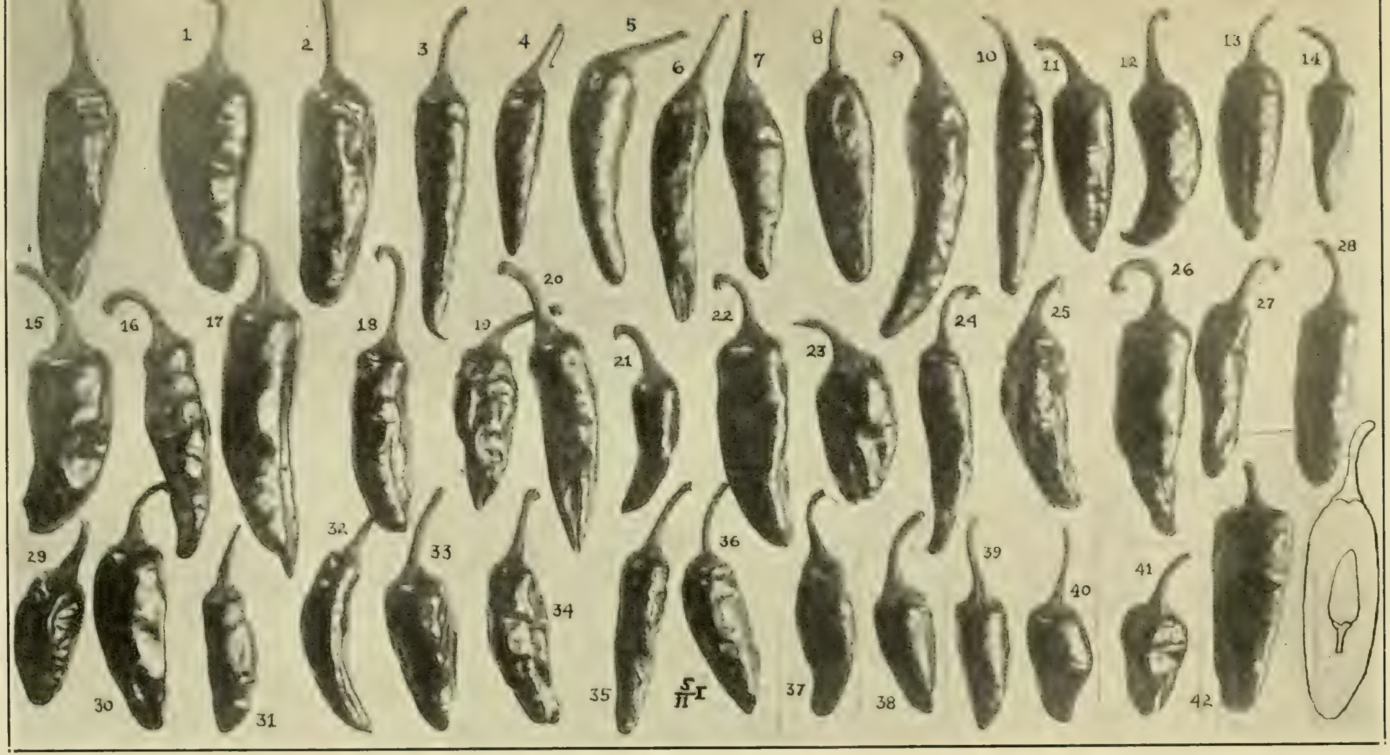
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PLATE XV. *Pepper Fruits.* A single fruit each for forty-two plants of "Black Nubian" upon "Coral Gem" in its second generation is shown, with a first generation sample in the upper left hand corner and an ink outline to scale of the two parents to the right and below.

Young fruits are generally green, of which there are two shades, namely, (2GYG) and (YG), the latter having decidedly more yellow and may be styled the light green as distinguished from the dark green of the first type. As pepper fruits mature, they pass through many changes, the series depending somewhat upon the presence or absence of the purple and whether the final color is red, scarlet, orange, or lemon. The color of maturity appears first in the core (base of the placentae); next in the seed-bearing surface; then the inner surface of the wall; and last, the outermost part. The development of the color is quite irregular—one-third, for example, of a tri-carpellary fruit showing a bright red before the other portion. In the long fruits, the tip is often quite green after the base has taken on its maturity color; and again, the opposite is true.

PEPPER CROSSES—"BLACK NUBIAN-CORAL GEM," (5/11).

The "Black Nubian" is a medium sized upright plant, little branched with a dark purple color pervading the whole plant and expressing itself most noticeably in the handsome purple flower and almost black fruit until maturity is approached when it passes into a lemon yellow, the dark color often remaining as more or less distinct streaks or blotches upon the yellow background of the medium large pendent fruits. In the "Coral Gem," the plant is much branched, comparatively low-spreading with the numerous small smooth red fruits upright, making the contrasts quite sharp between the two parents.

At the right of the lowest row (Plate XV) is an outline ink sketch of a fruit of each of the two parents, the one ("Nubian") pendent and the other ("Coral Gem") upright and smaller and drawn within the outline of the larger fruit, both of relative natural size.

Forty-two plants of the second generation were grown and some of the results of their study are given in the accompanying table.

PLANTS.		BRANCHES.			LEAVES.			FRUITS.									
Record number of plant.	Size of plant.	Number of branches.	Position.	Color.	Length in mm.	Breadth in mm.	Single or clustered.	Position.	Length in mm.	Breadth in mm.	Curved or straight.	Tip.	Color of ripe fruit.	Flesh.	Seed cavities.	Weight in gms.	Fruitfulness.
Blend	L	Many.	½ Inc.*	P‡	45	21	S	½ U†	65	20	S	B +	RRO‡	Thick	2–3	4.2	F§
1	L	Few	U	P	75	40	⅛ C	½ U	65	30	S	B	RO	Thick	2–4	12.3	F
2	S	Med'm	Inc.	P	60	32	⅛ C	P	70	25	S	B	RRO	Thick	2	6.6	F
3	M	Med'm	Inc.	SP	40	18	⅛ C	P	72	18	S	B	YYO	Thick	2–3	6.3	F
4	S	Few	½ Inc.	VP	45	20	⅛ C	½ U	53	15	C	B	RRO	Thick	2	4.3	F
5	M	Few	Inc.	VP	50	25	¼ C	U	70	20	S	B	RRO	Thick	2–3	6.3	F
6	M	Few	U	P	50	25	¼ C	U	65	15	C	B	RRO	Thick	2–3	3.6	F
7	S	Many	Inc.	VP	48	20	½ C	U	64	17	C	B	RRO	Thick	2	5.5	F
8	L	Many	Inc.	VP	45	22	¼ C	½ U	60	18	S	B	RRO	Thick	2–3	5.3	F
9	L	Many	Inc.	P	68	30	¼ C	P	80	19	S	B	RRO	Thick	3	9	M
10	L	Few	Inc.	G	80	32	¼ C	P	65	15	S	B	O	Thick	2–3	5.3	F
11	S	Few	U	SP	35	18	S	P	52	18	S	P	RO	Thick	2–3	7.5	M
12	L	Many	Inc.	SP	45	18	¼ C	P	50	18	C	P	O	Thick	2–3	5.3	F
13	S	Few	½ Inc.	P	60	28	C	P	50	23	S	B	RO	Thin	3–4	6.5	F
14	L	Few	½ Inc.	SP	30	13	S	P	35	16	C	B	RO	Thin	2–3	2.8	F
15	M	Few	Inc.	SP	50	22	S	P	62	25	S	B	RRO	Thin	3–4	9.5	M
16	L	Many	½ Inc.	VSP	65	32	½ C	P	70	17	S	B	O	Med'm	2–3	7.3	M
17	L	Many	U	VSP	70	28	S	P	80	24	C	P	O	Med'm	2–3	12.6	F
18	L	Many	½ Inc.	VSP	75	38	½ C	½ U	60	25	S	B	RRO	Thick	3–4	5.5	F
19	S	Many	½ Inc.	SP	50	23	¼ C	½ U	55	18	S	B	RO	Thick	2–3	4.5	F
20	L	Many	½ Inc.	SP	60	25	½ C	P	60	18	S	B	RRO	Thick	2	5.5	F
21	M	Med'm	U	SP	58	25	½ C	P	45	16	C	P	RRO	Thin	2	3.8	M
22	L	Many	U	VSP	45	25	¼ C	P	65	24	S	B	RO	Thick	2–4	9.5	F
23	S	Few	Inc.	P	52	32	S	P	48	22	S	B	O (spots)	Thick	2	5.3	F
24	S	Few	Inc.	SP	¶	¶	S	P	60	16	S	B	RRO	Thin	2–3	4.5	F
25	L	Many	Inc.	P	70	32	C	½ U	50	19	C	B	RRO	Thin	2–3	5.2	F

PLANTS.		BRANCHES.			LEAVES.			FRUITS.									
Record number of plant.	Size of plant.	Number of branches.	Position.	Color.	Length in mm.	Breadth in mm.	Single or clustered.	Position.	Length in mm.	Breadth in mm.	Curved or straight	Tip.	Color of ripe fruit.	Flesh.	Seed Cavities.	Weight in gms.	Fruitfulness.
26	S	Few	½ Inc.	SP	80	36	S	P	68	24	C	B	RO	Thick	2–5	9.5	F
27	S	Few	Inc.	SP	50	25	¼ C	P	55	17	C	B	RO	Thick	2–4	4.0	F
28	S	Few	U	P	50	23	½ C	P	55	24	S	B	RO	Thick	2	8.5	F
29	L	Many	Inc.	SP	60	30	½ C	½ U	40	21	S	B	O	Med'm	2–3	4.6	M
30	M	Few	Inc.	SP	50	20	S	P	60	22	S	B	RRO	Thick	2–3	8.6	M
31	S	Few	U	P	52	25	S	½ U	48	17	S	B	O	Thick	3–6	3.6	F
32	M	Few	Inc.	P	75	41	¼ C	P	65	25	S	B	YYO	Thin	2–3	4.5	Few
33	S	Med'm	Inc.	P	60	30	¼ C	P	52	20	S	B	RO	Thin	2–3	4.8	Few
34	L	Med'm	½ Inc.	SP	50	21	¼ C	P	55	18	S	B	RO	Thin	2–3	4.3	F
35	L	Few	Inc.	VP	65	30	S	P	55	18	S	B		Thin	3	4.5	F
36	S	Few	Inc.	P	35	18	¼ C	½ U	55	20	S	P	RRO	Med'm	2–3	4.2	M
37	L	Many	Inc.	P	70	35	½ C	P	52	18	C	B		Thin	2–3	4.2	M
38	S	Few	½ Inc.	P	55	25	S	P	48	20	S	B	O	Thick	2–3	4.3	F
39	L	Many	Inc.	P	58	22	¼ C	P	48	17	S	P	YO	Thick	2	4.3	F
40	S	Few	U	P	70	43	¼ C	P	35	21	S	B		Thick	2–3	5.0	F
41	S	Many	U	P	52	25	¼ C	¾ U	34	20	S	B	OYO	Thin	3	3.5	F
42	S	Few	Inc.	P	47	23	¼ C	½ U	58	20	S	B	RO	Thin	3	8.3	Few

*	Inc.	Incumbent (prostrate).
	U	Upright.
†	P	Pendent.
	U	Upright.
‡	P	Purple.
	SP	Slightly purple.
	VP	Very purple.
	VSP	Very slightly purple.
	G	Green.
	R	Red.
	O	Orange.
	Y	Yellow.
+	B	Blunt tip.
	P	Pointed tip.
§	F	Fruitful.
	M	Medium.
	Few	Unfruitful (or nearly so).

‖—No leaves remaining on this plant when other measurements were taken.

In size of plants, there were 17 large, 7 medium, and 18 small. There were 22 plants with few branches and 15 had many branches and 5 had a medium number; there were 10 upright plants, 22 incumbent, and 10 midway between.

The branches showed 23 with purple, 14 slightly purple, 4 very slightly purple, and 1 with no purple color.

The leaves were single in 11 instances, clustered in 2, and 29 were intermediates. The length and breadth of the leaves are shown below:

Length of leaves:

Millimetres	30	35	40	45	47	48	50	52	55	58	60	65	68	70	75	80
Instances*	1	2	1	4	1	1	8	3	1	2	5	2	1	4	3	2

Breadth of leaves:

Millimetres	13	18	20	21	22	23	25	28	30	32	35	36	38	40	41	43
Instances.*	1	4	3	1	3	3	9	2	4	5	1	1	1	1	1	1

In position of fruit, there were pendent 28, upright 3, and intermediate 11.

The length and breadth of fruits are shown below:—

Length of fruits:

Millimetres	34	35	40	45	48	50	52	53	55	58	60	62	64	65	68	70	72	80
Instances	1	2	1	1	4	3	3	1	6	1	5	1	1	5	1	3	1	2

Breadth of fruits.

Millimetres	15	16	17	18	19	20	21	22	23	24	25	30
Instances	3	3	5	9	2	6	2	2	1	4	4	1

As to direction of polar axis, the fruits varied greatly and somewhat upon each plant but in general, 31 were nearly straight and 11 were more or less curved.

The tips were pointed, 6; blunt, 36.

The flesh ranged from 13 thin, to 25 thick, and 4 intermediate.

The seed cavities ranged from 2 to 6; and the weight from 2.8 grams to 12.6 grams.

The productiveness was: very fruitful, 0; fruitful, 30; medium, 9; and unfruitful (or nearly so), 3.

EXPERIMENTS WITH SQUASHES.

The North Lot of more than an acre, six widely scattered small blocks of corn excepted, was employed in experiments with squashes of many kinds, including summer and winter sorts and gourds together with a large number of crosses previously made among them. For the bush varieties, the midsummer drought

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*One plant had no leaves remaining when it was measured.

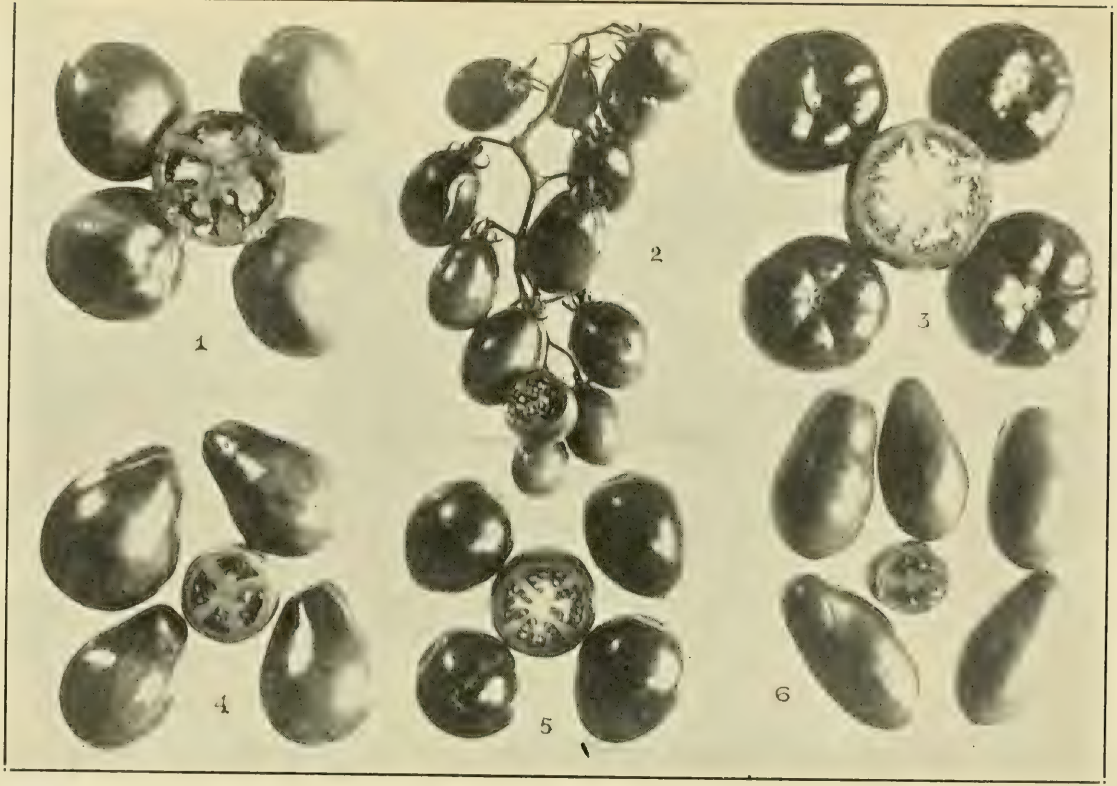


Plate XVI. *Tomato Crosses.* At 1 is shown the "Peach Salad"; 2, "Pink Coarse leaved Plum"; 3, "Jersey Orange"; 4, "Pink Giant Pear"; 5, "Cupid"; and 6, "Banana."

was particularly serious and they rarely matured more than two fruits to the plant; but the vine sorts did much better and one plant of a cross, for example, produced 54 fruits of marketable size, and another, "Angora," gave nearly a quarter of a ton of fruits.

Squashes offer an opportunity for a late field study of the fruits, and during November a large number of records was made of various features of the crop. Time is too short before going to press, to permit of reporting here the results of the tabulations of weights, measurements, enumerations, etc., and they must be given elsewhere. Substantial progress has been made toward a knowledge of the habits of squash plants and their behavior along chosen lines when varieties with certain points of difference are bred together.

Experiments with Tomatoes.

The tomatoes occupied nearly an acre, chiefly in the central part of the Home Grounds, the main portion consisting of sets of crosses, direct and reciprocal, in the first generation of the leading types. These are named and briefly considered with some preliminary conclusions in another part of this report.

In continuation of the work of breeding and selecting for choice sorts of tomatoes, some progress has been made. Several selected crosses for length of fruit have been grown and encouraging results obtained and at the same time some particularly desirable kinds have arisen.

"THE PEACH SALAD."

This is a pink-fruited strain that came out of the derivative cross of the "Magnerose" upon a cross of the "Giant" upon the "Globe," expressed by the formula, 227//56/194, now in its fourth generation. The fruits are medium sized and particularly attractive because having the coloring of the orchard tree peach. Samples of the "Peach Salad" are shown at 1 in Plate XVI. As this was described somewhat at length in the last annual report, it need not be here further considered save the statement that it has maintained its high standard for fine flavor and great attractiveness during the past season.

"THE PINK COARSE-LEAVED PLUM."

This tomato, an average cluster of which is shown at 2, has again proved an attractive sort and illustrates how repeated combinations can develop novelties. Its formula is 103/181///75//75/26, which shows that "Magnus" (75) was bred upon "Crimson Cushion" (26), then "Magnus" again was used as the pollinator and upon this the cross of "Ponderosa" (103) upon "Sumatra Fig" (181) was bred. It is not likely that this coarse-leaved, somewhat plum-shaped sort will become popular as the fruit is not of full marketable size.

THE "JERSEY ORANGE."

This unusual sort has sample fruits shown at 3. It has proved a very attractive kind during another year. The parentage is simple, namely, the "Station Yellow" (210) upon "Dwarf Stone" (210/169). There is a possibility of this creation being of commercial value because the plants as such are satisfactory and the fruits of good form and flesh have a fine rich golden color, quite unusual in tomatoes.

"PINK GIANT PEAR."

This novelty, shown at 4, is the result of breeding "Ponderosa," "Sumatra Fig," "Magnerosa," "Globe," and "Magnus" with the formula 103//103/181///227//194/75. There is a distinct neck as seen, the main portion being quite thick-walled and the cavities four or five in number. Frequently the fruits are broad suggesting that two had been united from their beginning as may be seen in three of the large specimens. While this particular strain may not be of much commercial value, it is likely that it will be a step towards one of great merit.

THE "CUPID."

This unusual tomato is a result of breeding together "Earliana" and "Jewel" (33/66) for five generations. The fruit is a choice red of medium size and broad egg-shape, with the blossom-end having a well-defined point, thus producing an outline of a heart in longitudinal section and suggesting naturally the name that has been assigned to it. There seems to be no reason why this variety might not be of much merit as a forcing sort for salads, etc., out of the regular season, as the slices are very attractive when served upon lettuce.

THE "BANANA."

This form has appeared upon the breeding grounds as a result of a double combination, namely, "Magnus" upon the cross

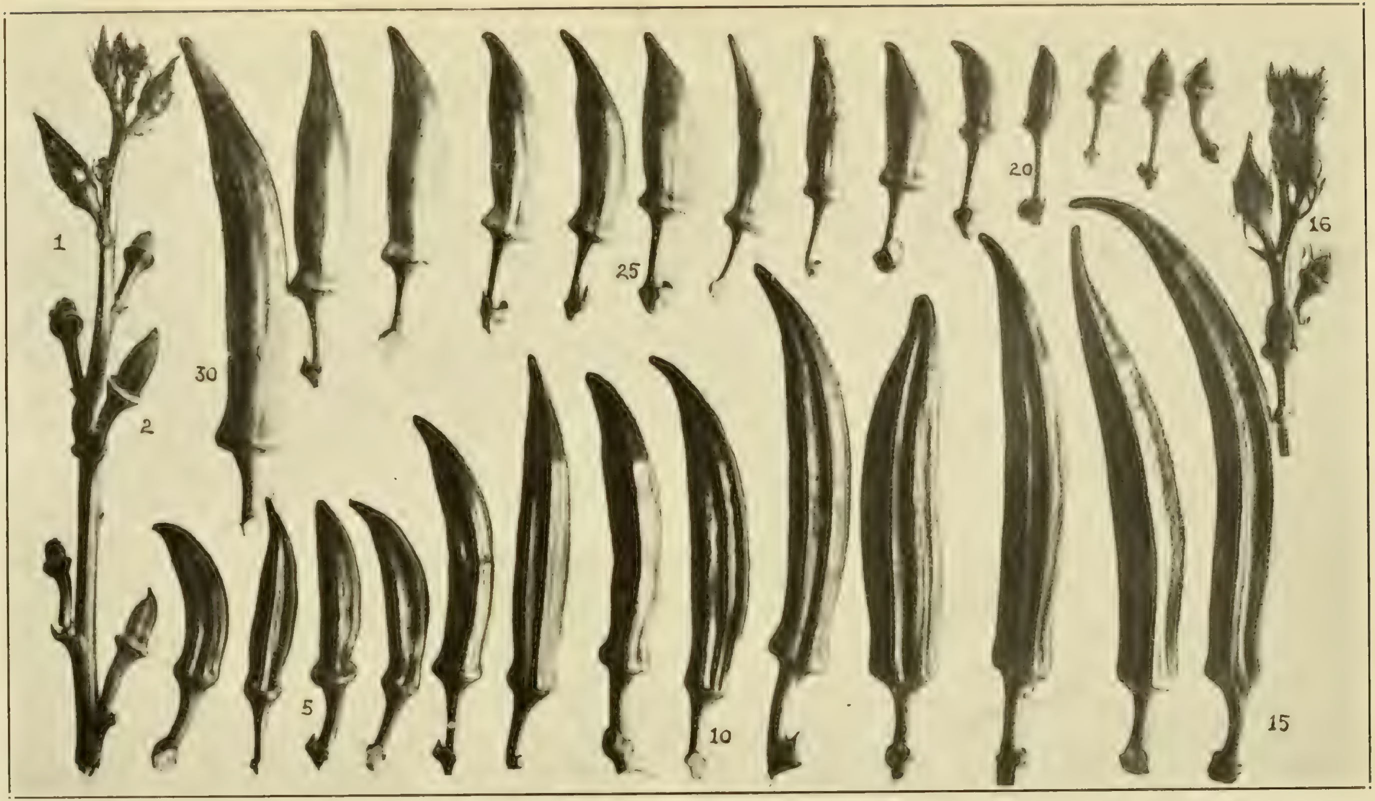


Plate XVII. *Okra Fruits.* From 1 to 15 is shown a series of okra pods from the "blossom stage" to maturity for a ridged variety, while from 16 to 30 is shown a similar set for a smooth sort.

of "Yellow Prince" upon "Golden Fig" after the formula, 75//148/173. The fruits are unusually smooth, slightly broader in the blossom-half as shown at 6. Here again in itself this strain has no special merit, but offers an opportunity to build upon a form of fruit with a long axis so as to obtain a commercial variety that should be generally acceptable.

HYBRID TOMATOES.

Upon Strip II was grown a block of "Magnus-Currant" hybrids in the first and second generations with a few specimen plants of the parents. The following table gives a few of the results in stem, leaf, and fruit, with the 191 second generation plants:

Stem. Hairy	137	Leaf. Fine	155	Fruit. Red	146
" Smooth	54	" Coarse	36	" Pink	45

Hairy, fine and red	83	Smooth, fine and red	36
" " " pink	26	" " " pink	10
" coarse and red	22	" coarse and red	5
" " " pink	6	" " " pink	3

DEVELOPMENT OF THE OKRA FRUIT.

Plate XVII shows in the lower portion, from left to right, a set of fifteen fruits of the grooved type in various stages of development (1, 5, 10, etc.) from the time when the flower falls, on to the matured pod (15). In like manner, in reverse order, in the upper row is shown a similar set of the smooth type of fruit.

At the time of blooming, the fruit stalk averages 25 mm. ± in length and it increases a comparatively small amount throughout the development of the fruit, attaining only 35 mm. ± at maturity. By running the eye along the two sets of fruits above mentioned in the plate, the fact as stated is fully established.

The receptacle increases from 13-14 mm. ± to 24-29 mm. ± or, in general, the base of the fruit doubles its width during its development. There is usually quite a constriction in the fruit just below the base, which is well shown in both sets in the engraving.

Measurements of the growing fruits taken near the middle show that there is an expansion of the fruit from 10 mm. to 25 mm. ±, or two and a half times its width, when leaving the bud condition.

The greatest growth in the okra fruit is, of course, in length, this amount depending upon whether the kind is "short-podded" or "long-podded" and with the latter it may be from 13-14 mm. ± to 170-190 mm. ±.

The long fruits are generally more or less curved, as shown in the plate, and it seems likely that the bending bears some relation to seed-development within and when this has been faulty, there is a retardation of growth and that side becomes concave. It is not uncommon to have a double curve in a long pod.

PEPINO OR THE MELON SHRUB.

During the past season several plants of the Pepino, Melon Shrub, or Melon Pea (*Solanum muricatum* Ait.) have been grown for breeding with eggplants, peppers, and tomatoes. The plants are handsome bushy herbs, with smooth long leaves and producing bright bluish purple flowers in great profusion, but rarely setting fruit, that is, there may be a thousand blooms to one fruit. The latter were as large as goose eggs, which they resemble somewhat in shape but were quite pointed at the blossom-end and streaked and splashed with violet purple upon a background of dull pale green. The specimens were in all instances seedless, whether treated with pollen from the eggplant, pepper, or tomato, or left to themselves; and as a maternal subject for breeding, as was expected, proved worthless for the first season, at least.

The fruit is satisfactory when treated as that of the eggplant, the flesh flavor being something like that of cucumbers, but under our conditions it is not recommended because of the few fruits that are produced. In the tropics where it is native, especially at elevations where there is a comparatively cool and long season, the pepino is of economic importance. With us perhaps the most interesting characteristic is the formation of fine well-shaped fruits that are seedless, the firm watery flesh occupying practically all the interior.

BREEDING AMONG ORNAMENTAL PLANTS.

The front border of the breeding grounds, as usual, was occupied with ornamental plants, among which as an aside some studies in heredity have been prosecuted.

PINK-CARNATION HYBRIDS.

The pink and carnation hybrids reported upon last year, accompanied with a full page plate, have been very attractive the past season and some of them show much to merit their extensive propagation for bedding plants.

FOXGLOVE HYBRIDS.

The hybrid plants of *Digitalis purpurea* L. and *D. lanata* Ehrh. have been conspicuous for their tall wands of small cream flowers that uniformly fail to produce seeds. The plants show more or less variation in size of all parts and to the breeder's eye behave quite as true hybrids.

NICOTIANA HYBRIDS.

Hybrid plants of *Nicotiana Sandrea* upon *N. alata* L. and O. continued the peculiar display of showy flowers of unusual shades through the latter half of the season.

PANSY HYBRIDS.

There were several patches of the combination of *Viola tricolor* L. upon *V. tricolor* var. *arvensis* DC., blooming freely from very early spring until late autumn and while not with large flowers, they make up in numbers for any lack in size, and are desirable for low perennials.

"GOLDEN BOWL-OKRA" HYBRID.

The one blend plant considered and figured in the Annual for 1909 (p. 320) was transferred in autumn to the greenhouse where it continued to bloom and fruit so that several close-fertilized seeds were obtained larger than the few produced in the open, and from them three plants resulted. The original hybrid plant was again placed in the open (May, 1910), and produced blooms and fruits, but grew only about four feet high, yielding thirty-six pods which were smaller than those of last year. Of the three plants of the second generation, two reached maturity, attaining a height of six feet, and bore flowers similar in color and shape to those of the blend, some flowers being even larger. One bloom in particular on September 14th had a diameter of 5½ inches and later opened to 6⅜ inches. The pods are larger than those of *Hibiscus Manihot* L., having the hairiness of that parent, and, while no actual test has been made, they would probably not be an improvement over the okra parent (*H. esculentus* L.) for table use. As an ornamental for grouping at the side of a lawn, it promises to have some value.

PELARGONIUM (GERANIUM) CROSS.

Two years ago a cross was obtained with "Anastasia"—a delicate rose-pink single-flowered variety, upon "Castellane" bearing dark red double flowers. The plants coming directly from the seeds thus secured were unusually attractive in all parts and particularly so in the pure brilliant red of the blooms borne in large spherical clusters. Nineteen plants of the second generation were grown the past season by themselves and showed many marked differences in size of plant, zonal markings of foliage, etc. No double blooms appeared and in colors the flowers were grouped as follows: pink, 7; red, 7; and pink and red, 5. The pinks varied as to intensity of color and there were at least two shades of red, one similar to the blend (scarlet) and the other darker (crimson) but no flowers were exactly like either parent.

A circle in the lawn was set with cuttings from the first generation plants and these were all alike and proved uniform in bloom and very attractive in the large size of the scarlet clusters. To this meritorious ornamental plant, the name of "Rutgers" is given because of its bearing the color of the College upon whose grounds it was originated.

Experiments in Limitation of Fruit Bearing.

During the season some experiments have been made in limiting the number of fruits borne by a plant by removing all or nearly all the blossoms as they appear.

TOMATOES.

A block of sixteen plants of the "Magnerosa" was selected where check plants of the same lot grew side by side. All were grown with the single stake method that they might be held from the ground and the more easily studied. Of this rectangle of plants, alternate ones had all the flowers removed and the other eight were limited to one fruit. In some of the latter instances after the plants had matured the single fruit, they were permitted to bloom and to form fruit without further limitation.

Shortly after the fruits began to form upon the untreated plants, it was noted that these were smaller than those kept free of fruits or limited to one—which, by the way, is not far different with this kind of crop from no fruit at all.

From the limitation plants, the number of flower clusters removed was very large and indirectly this shows that the growth of the plant to produce so many new inflorescences was far in excess of normal plants that had the production of flowers greatly checked by the presence upon the plants of a full load of forming fruit.

Plate XVIII. *Fruit Limitation.* The upper half shows two tomato plants; the right one limited to one fruit, the other bore without stint. The conditions were reversed with the two eggplant plants shown in the lower half.

The marked differences in the vegetation of a normal and no-fruited plant are shown in Plate XVIII where the total growth of stem and foliage was in marked excess of the normal when the bearing of forming fruit was proscribed.

The single fruit borne by a plant showed an increase in weight and firmness of texture but no change of form. In other words, any hope of getting a very unusual size in the fruit by this restriction was not realized. While it is doubtless true that the excessive formation of fruit conduces to inferior size and quality, and, contrariwise, thinning of fruits upon plants with a strong tendency to prolificness is very advantageous, it seems quite evident that there is a certain limit set for every plant as to the actual size of its individual fruits; and beyond this there is no hope of carrying it by any methods of culture, whether by excessive nutrition or thinning, etc. Thus ringing of branches for prize-taking specimens, however successful, never overcomes the varietal characteristics, one of which is size; and while well-thinned fruit may be so different from the ordinary specimens as to seem new, this is due to a lack of familiarity by the observer with the variety in its best estate. There is a large field in developing a knowledge of the models of plant products, that is, the most highly developed expression of the commercial product of our crop plants. The effect of this restriction of product upon the seeds of plant offsprings (in other words, upon the descendants through succeeding generations) is a large part of the project and one that must need years of actual trial.

The upper half of Plate XVIII shows two tomato plants; the one upon the right had been limited to a single fruit, while the left-hand plant in an adjoining hill was allowed to bear fruit without stint. As a result, the former produced a large output of stems, leaves and blooms, and the latter remaining comparatively small bore a full quota of fruits.

EGGPLANTS.

In the same manner as with the tomatoes, two sets of limitation tests were carried out with eggplants,—one with the cross of "Black Snake" upon "Round White," and the second, "Black Pekin" upon "Long White," specimen fruits of both of which are shown elsewhere in this report. The large number of plants of these crosses (101 and 127 respectively) permitted of a more extended test and here twenty plants composed each block taken from the midst of the whole plot of each cross.

Results given in tabulated form below agree generally with those for the tomatoes. The plants having no fruits permitted to be set, grew much larger than those in normal fruit-bearing condition and the stems were noticeably thicker and bore a greater number of leaves which in themselves were different in texture and lobation from the check plants. The flowers were produced in great numbers and those plants that were permitted to hold their blooms after the single mature fruit had been removed were laden with many young "eggs' when frosts put an end to the test.

The following table shows some of the results obtained:

Condition of test.	Number of plants.	Average number of flowers.	Average weight of plant.	Average weight of fruits.	Average number of fruits.	Average total weight.
I. "Black Snake" upon "Round White."						
No fruits to plant..........	10	425.3	107. oz.	....	0.	107.
One fruit to plant.........	10	56.9	52.9 "	8.5 oz.	1.	61.4
Check, unlimited fruitage...	8	.....	31.2 "	7.2 "	15.6	143.5
II. "Black Pekin" upon "Long White."						
No fruits to plant	10	116.4	80.1 "	.....	0.	80.1
One fruit to plant.	10	64.	73.9 "	21.4 "	1.	95.
Check, unlimited fruitage...	8	.....	55.1 "	15. "	6.6	154.

It is seen that the average number of flowers upon "one-fruited" plants was 60.4 but when all fruits were removed it arose to 270.8 or a more than four-fold increase. When plants are permitted to set fruits freely and they are not removed at table maturity, the number of blooms is very small. In eggplants, at best the number of ordinary marketable fruits is small and the influence of the presence of one fruit to seed maturity is great upon the tendency to further productiveness. It is shown by the table that the plants with no fruits weighed more than those with one fruit and very much more than those with a full crop. Furthermore, the single fruit produced upon a plant under limitation weighed somewhat more than the average grown upon the check plant. In both sets, the total weight was greatest with the normal plants, due to the very large percentage of the weight being made up of the fruits, that is, two or three times the weight of the plants bearing them.

Here as with the tomatoes there was no unusual size obtained by the isolated fruits, they not exceeding the size of those at times produced upon control plants. In the case of eggplants, the number of fruits that a plant bears is few and therefore, as might be expected, there was a difference in vigor of plant-vegetative development, between the plants with no fruit and those limited to one and always in favor of the former.

The lower half of Plate XVIII shows a plant, upon the right, that was grown without fruit, while the other was left for its ordinary development and was much smaller than the one that was de-flowered, from week to week, of its numerous blooms.

BUSH BEANS.

Two commercial varities of beans were used in this test, namely, "Black Valentine" and "Davis Wax." The plants were grown: I, (1) several in each of the fifteen hills, (2) singly in fifteen hills for each kind; and II, (1) with all the pods left, (2) with only one pod left, and (3) with no pods left to grow.

The following table shows some of the results:

"Black Valentine" (45)	Number of plants.	Average number of flowers.	Average weight of plant.	Average number of pods.	Average weight of pod.
Several plants in hill.					
No pods to plant. .	40	147	.95 oz.	0	0
One pod to plant. .	38	121	1.25 "	1	.13 oz.
Unlimited fruitage	45	. . .	.42 "	12	.08 "
One plant in hill.					
No pods to plant. .	5	212	6.3 "	0	0
One pod to plant. .	5	130	2.5 "	1	.25 "
Unlimited fruitage. .	5	. . . .	1.2 "	27	.09 "
"Davis Wax" (112)					
Several plants in hill.					
No pods to plant. .	21	252	4.2 "	0	0 "
One pot to plant. .	17	160	1.4 "	1	.36 "
Unlimited fruitage. .	22	. . .	.45 "	12	.10 "
One plant in hill.					
No pods to plant. .	5	260	5. "	0	0 "
One pod to plant. . .	5	333	5.5 "	1	.3 "
Unlimited fruitage. .	5	. . .	1.5 "	23	.11 "

When the plants were permitted to form pods, the blooming season was short and the number of flowers small (not counted).

It is shown that when the plants were grouped in hills the output of flowers per plant averaged 170, while the single plants had 234 blooms; those with one pod left averaged 186; and with no pods 218. All these groups of plants had the blooms removed and counted through a period of two months and in fact the plants formed few branches and leaves until beyond the first frosts from which they were protected at night by covers.

The length of the "Black Valentine" plants was greatest when grown in a hill close to their fellows, but in the "Davis Wax" the difference was but slight. Varietal peculiarities may account for the tendency to be bushy or to "run."

The weight of the normal plants was taken after they had become quite dry and the leaves and some small branches had fallen. It was quite impracticable to get the other plants into the same condition and therefore the table of average weights is not fully comparable in all its parts. At a glance it is seen that the grouped plants had less dry weight than the others, and the average number of pods (12) was less than half that of the ones grown singly (25).

Pods grown alone uniformly weighed and measured more on the average than those produced without limitation on the plant. The table shows that the weights were sometimes more than three times that of the normal crop and in measurements the increase was in both length and breadth of the pod.

During the autumn months this experiment was very striking because of the maturing and defoliation of the normal plants which stood leafless among the limitation plants which increased to unusual size, bloomed in profusion and held the foliage green for weeks after the first frosts, from which they had been artificially protected.

Here the pods or their contents were not materially different from those produced normally but it remains to be determined what potencies may be stimulated or what new ones acquired by the conditions under which the offspring were nurtured and developed.

Plate XIX shows unsatisfactorily the differences at a time when the pods were maturing upon the check plants. The "Black Valentine" with full crop and with no pods in mid-season is shown at 1 and 2 respectively, and the "Davis Wax" at 3 and 4. The contrasts here are far less than developed later in the season.

BUSH SQUASHES.

The limitation test was attempted with two varieties of bush summer squashes, namely, "Mammoth White Scallop" and "Strickler's"; but no second fruits formed upon the former. Seven plants of the "Strickler's" matured a single fruit each, while only two had a brace of squashes of full size. From these nine instances the following figures are obtained:

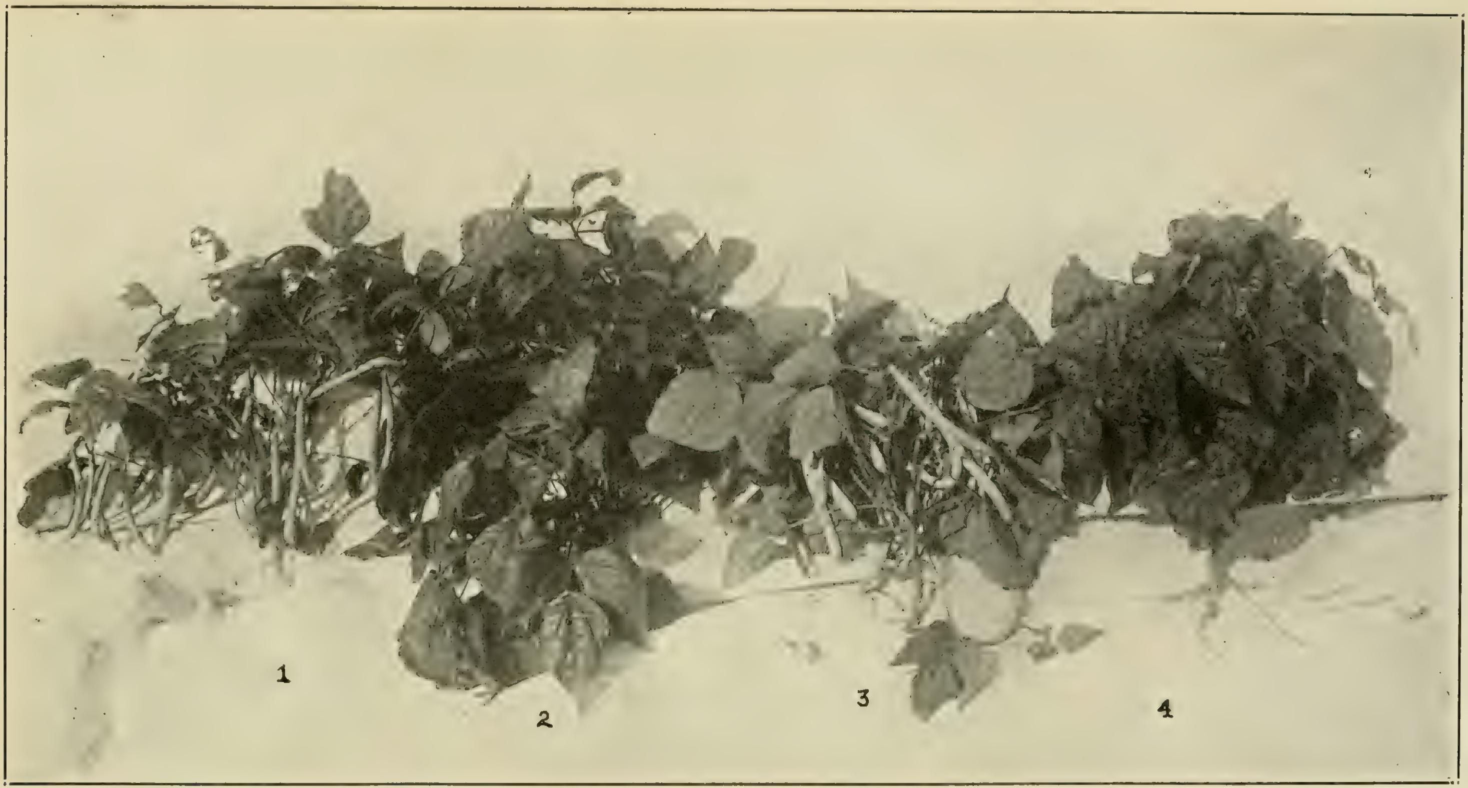


PLATE XIX. *Fruit Limitation.* A full-fruited "Black Valentine" plant is shown at 1, and a fruitless one at 2; at 3 is a fruitful "Davis Wax" plant and a de-fruited one at 4.

Plant.	Length of plant.	Weight of plant.	Number of internodes.	Weight of 1st fruit.	Weight of 2nd fruit.	Average.
1.	60 cms.	629 gms.	23	1205 gms.		
2.	80 "	4143 "	38	620 "		
3.	45 "	657 "	32	1060 "		
4.	52 "	1657 "	21	1575 "		
5.	55 "	1571 "	18	1555 "		
6.	56 "	572 "	21	550 "		
7.	117 "	2000 "	24	815 "		
Average. .	66.4 "	1589.8 "	25.3	912.9 "		
8.	85 "	2143 "	18	1350 "	640 gms.	995 gms.
9.	63 "	4714 "	29	998 "	1020 "	1009 "
Average. .	74 "	3428.5 "	23.5	1174 "	830 "	1002 "

While the number of instances in this test is too small for any generalization, it suggests that the size and weight of the plant do not govern the size and number of fruits or that the weight of any fruit is correlated with number within the same variety; but on the contrary, the average size of a mature fruit is quite near to a fixed weight—in this instance approximating 1000 grams.

NOTES UPON THE RAYS OF THE RUSSIAN SUNFLOWER.

Seeds from a commercial packet of the Russian Sunflower (*Helianthus annuus* L.) were planted in some vacant hills among various crops upon (1) comparatively rich soil and (2) poor soil, the point being to note any difference that might obtain in the number of ray flowers. There were seventy-eight plants, forty-one in rich (garden) soil and thirty-seven in poor (farm) soil.

The number of rays ranged from 17 to 42 and it is noted that in the rich soil, the heads (plants) with 34 rays were the most numerous (6), while with those in poor soil the prevailing number (6) was 21. There were no plants with above 36 rays upon the poor soil, and none below 21 upon the rich soil.

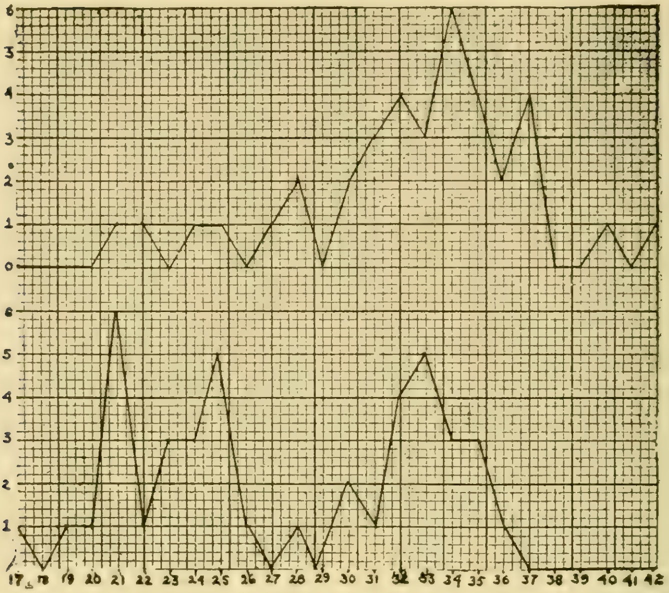


Diagram showing ray-numbers at the bottom and the number for each of them at the left. The upper half is for the rich soil and the lower for poor soil.

The accompanying diagram shows to the eye at a glance, the results in terms of number of rays for the two soil conditions.

In a neighbor's field, a few sunflowers of the branched type were grown and upon these a record was made.

	Terminal.	1st Lat.	2nd Lat.	3rd Lat.	4th Lat.
Plant. 1............	34	23	21		
" 2............	passed	13	15		
" 3............	30	15			
" 4............	21	23			
" 5............	23	16	18	17	17
" 6............	33	21	22	18	19
Average............	28.2	18.5	19	17.5	18

These six instances suggest that with reasonably large numbers there might be a decided difference between the terminal and first lateral head and possibly some decline in the number of the rays in the later formed heads farthest down the stem.

A small plant was found beneath and over-shadowed by a large one that while but eight inches high had a small head a half-inch in diameter and with five ray flowers only; its leaves consisted of four pairs with a few alternating bracts near the

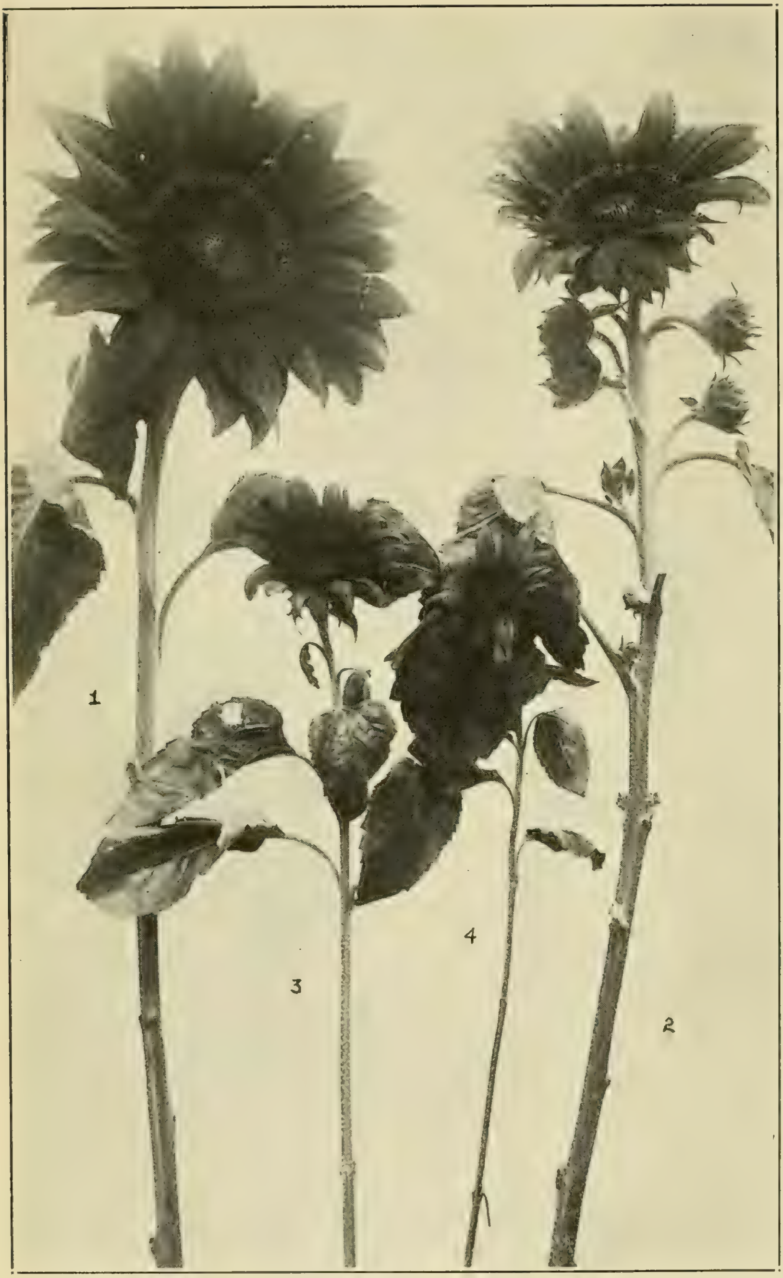


PLATE XX. *Sunflower Heads.* At 1 is shown an unbranched type of sunflower; at 2 a branched form, with small secondary heads; starved plants are shown at 3 and 4, the rays being much reduced in number and size.

base of the head. Another somewhat similar plant was found, 18 inches high with 20 rays and the leaves for the lower half of the stem in pairs like the cotyledons.

A study of the leaf arrangement showed that with the smaller plants upon the poor soil the spiral is of the $\frac{2}{5}$th series, that is, the sixth leaf is over the first with two revolutions around the stem between, while the large plants of the richer soil represent the $\frac{3}{8}$th series. There is, however, some confusion in the phyllotaxy for a pair of leaves may be present in any plant large or small or there may be two close together at the same level upon the stem, as if the internode had failed to elongate.

It seems quite evident that the series in phyllotaxy are easily modified in the sunflower and that, with further study, cases of all the series from $\frac{1}{2}$ to $\frac{21}{55}$ may be met with, those from $\frac{2}{5}$ to $\frac{13}{34}$ being in sight in the present very limited numbers.

The subject of color in the sunflowers in question, engaged attention. While the plants generally were green throughout the stem and leaf, some plants had the pink color of the stem limited to the hypocotyl; others showed the same pink ("purplish") color throughout the stem and main veins of the leaf. Yellow was the prevailing color for the disks but some showed dark at a distance, this difference being due to the maroon tips of the many tubular corollas. This dark color was quite uniform in the same head but varied greatly among the "dark faced" heads. There is much difference noted in the color of the seeds (fruits) as they present their larger ends upon the maturing disk and in this respect range from dark brown to nearly white (gray). Each fruit is usually marked with alternating lines of dark and light in which there is a remarkably wide range of variation.

Plate XX shows the upper portion of four sunflower plants. The largest (1) is unbranched and with 33 ray flowers, the next (2) is of the branched type, that is, has a number of secondary heads borne below the terminal in quite regular order, the oldest being uppermost. At 3 is a small plant, grown under unfavorable conditions with 21 rays and at 4 is a still smaller one with 13 rays; both these plants have the lower leaves in pairs.

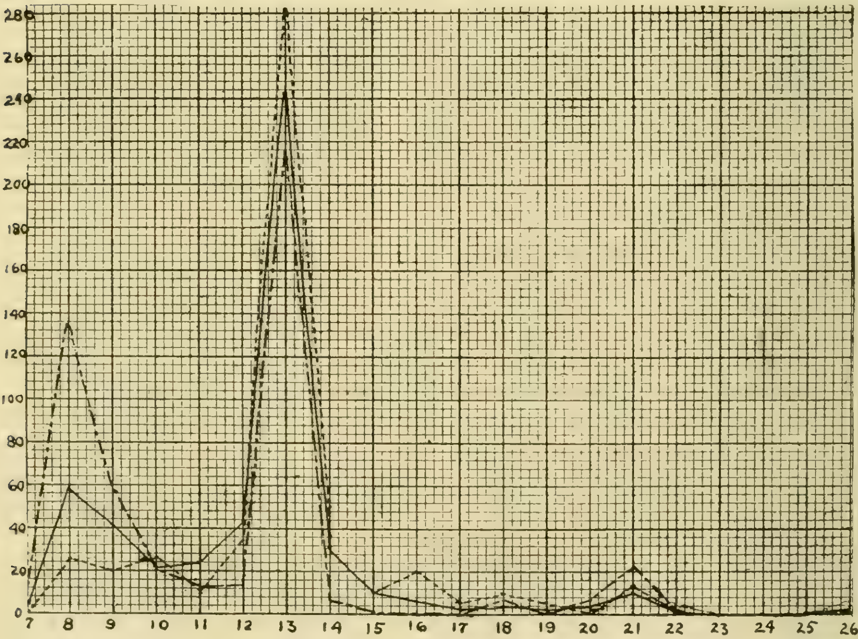
THE RAY FLOWERS OF THE CONE FLOWER.

While at Sea Girt, observations were made upon the ray flowers of the "Cone Flower," "Black-eyed Susan," or "Yellow Daisy" (*Rudbeckia hirta* L.) which is rapidly becoming one of the showy weeds of the State.

The chief point considered was the number of the ray flowers, but regard was also had of the size and shape of the corollas.

Counts were made of all the heads in flower upon each of one hundred plants. There is an evident central head in each plant which is marked terminal (T) in the following table, and the next below it, and the second in order of blooming, is styled the first lateral (1st); and the others in order are second, third laterals, etc. (2nd, 3rd, etc.), the last, whether the third or ninth (both extreme cases) being the youngest.

Position of head	Number of Ray Flowers.																			Total.
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	26	32	42	
T.......	0	5	4	5	2	7	56	6	2	4	1	2	1	0	3	1	1	0	0	100
1st.....	0	10	9	3	6	12	45	7	2	1	2	0	1	1	0	0	0	1	0	100
2nd.....	1	9	7	5	6	10	48	5	2	1	0	1	1	0	2	0	1	0	0	99
3rd.....	0	8	5	5	7	6	34	7	3	0	0	0	0	1	1	0	0	0	1	78
4th.....	1	5	7	1	1	6	26	4	1	1	0	0	0	1	1	0	0	0	0	55
5th.....	0	6	7	2	1	2	14	1	0	0	0	0	0	0	2	0	0	0	0	35
6th.....	0	9	1	0	1	0	9	0	0	0	0	1	0	0	1	0	0	0	0	22
7th.....	1	3	1	1	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	13
8th.....	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3
9th.....	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Total...	3	57	41	22	24	43	241	30	10	7	3	4	3	4	10	1	2	1	1	507



The accompanying diagram shows graphically, by the solid line, the distribution of the 507 heads among the ray numbers from 7 to 26, the single instance of a 32-rayed and a 42-rayed head being omitted. By means of the fine dotted line is shown the curve constructed for the terminal heads, and the bars and dots indicate the curve for the fifth to the ninth lateral heads, all three curves from the deduced basis of 507 instances.

The Effect of a Midsummer Drought upon Ligneous Plants.

The growing season of 1910 was unusual in that there was a prolonged drought in July and August followed by copious rains. So dry was it that many of the various truck crops were materially shortened as, for example, sweet corn and summer squashes noted elsewhere in this report.

In connection with the checking of vegetation in midsummer, some observations have been made upon the foliage and young stems of several trees and shrubs. Ligneous plants upon dry knolls naturally have yielded interesting results far in excess of those that grow in lowlands or along streams and ponds that have a constant subterranean source of water.

As a preliminary, it may be stated that plants generally have the first leaves somewhat smaller and often of different shape from those that are produced later upon the same branch. There seem to be evident reasons for this as these leaves were started in a bud that was preparing for a period of rest (winter) and that finally has its exterior made up of specialized leaves that have their service in protecting the delicate parts within. A minimum of food combined with a degree of confinement may be sufficient to account for the lack of size and any special shape of the first leaves. Furthermore, there is a demand for small leaves quickly formed to prepare food for the shoot that later will bear larger leaves which in turn place the smaller, earlier make-shifts, so-to-say, literally in the shade. As a matter of fact, twigs that have attained to the full stature of mid-season growth generally have dropped their first formed leaves for they have passed the period of their usefulness.

A quite limited study of the early leaves, together with measurements, leads one to the opinion that the short broad type is to be associated with that of the early development of the bud from its resting condition, while a longer and narrower form is associated with that of the mid-season when the growing twig has its terminal bud free from all incumbrances of bud-scales and is abundantly supplied with food substances directly from the young leaves that are more or less closely associated with it.

Many plants at this date (September 10th) show leafy branches with two sets of leaves more or less evident. For example, the California privet (*Ligustrum Japonicum* Thunb.) twigs show all their leaves (evergreen) intact, the basal ones little more than kidney-shaped bodies sitting upon the stem, while the next pair is an inch or so broad, deeply notched at the tip and strikingly different from the ovate-lanceolate leaves which characterize the upper portion of the stem. These same twigs show a foot or two above the insertion with an older branch a repetition more or less complete of the small reniform or obcordate leaves that gradually measure much longer and become taper-pointed as the tip of the stem is approached.

As these observations were not begun until some weeks after the refreshing rains came, one can only infer that which actual sight at an earlier date might better have supplied. It would seem that during the prolonged drought the privet twigs ceased to produce new pairs of leaves and the terminal buds assumed somewhat the condition of those that are in late autumn going into winter quarters. How much there was of reserve material being centered at the base of the bud, it is not possible to determine; but with the return of water supply to the roots, the buds resumed growth with the formation of abbreviated internodes and broad notched pairs of leaves that seem to be incident to the initial growth of stems from winter-buds in this hedge plant.

A forest nursery illustrates the point in hand and, to be particular, a single stem of white oak is here described somewhat in detail. The stem is divided into the old and the new growth of the season, the former being quickly distinguished from the latter by the number and size of the leaves. The new growth (19 centimeters) has eight leaves, the fourth, fifth and sixth from the base being the largest, the first and the eighth being the smallest. At the base of the new growth there are scale scars below which are eight small leaves in a distance of 6 cm. The leaves vary somewhat in size but average 7 cm. long and 3.4 cm. broad and have seven lobes upon each side extending halfway to the mid-rib. The third leaf upon the new growth is 15 cm. long, 7 cm. broad, with only three lobes upon either side and extending halfway to the mid-rib. The contrast is still stronger between the last leaf of the old growth and the first upon the new, the latter with two side lobes being nearly as broad as long, while the former is a long narrow leaf with a deeply many-notched margin.

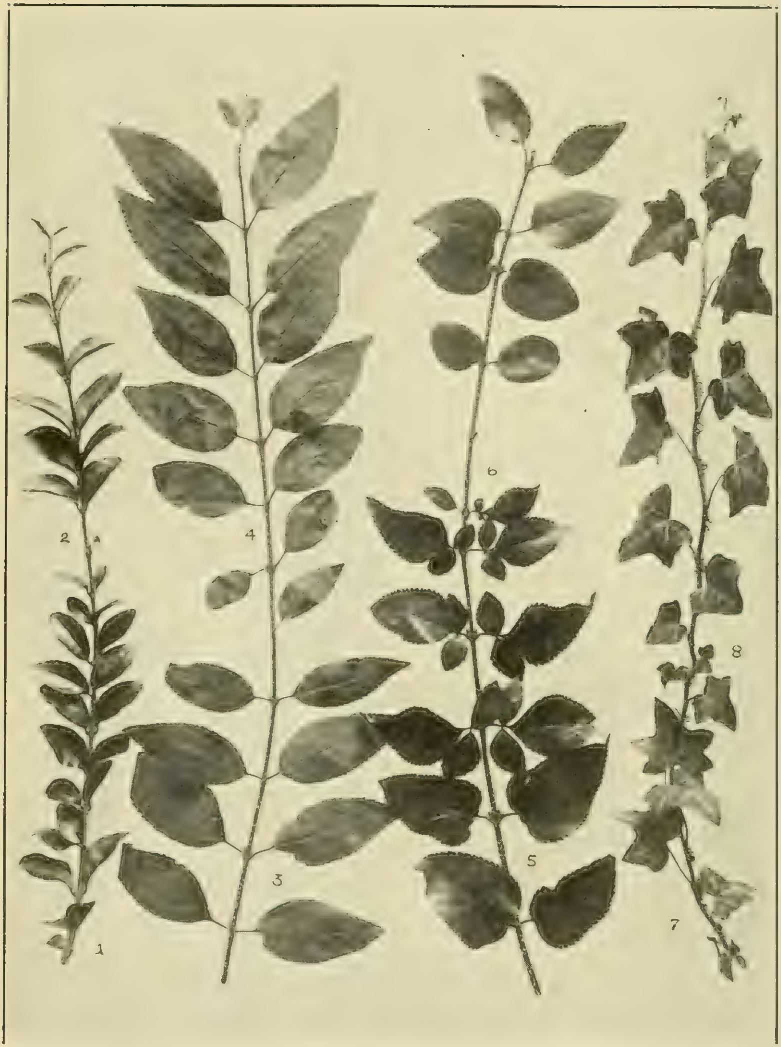


Plate XXI. *Checked Growth of Plants.* At 1 is shown a branch of California privet with its normal small leaves at the base and the zone of arrested growth at 2. A similar region is shown at 4 and 6 for two Forsythias, and at 8 in the English ivy.

In the ash there is a similar difference between the old and the new growth of the year. Thus the end leaves of the old wood are 18 cm. long with six pairs of small oval leaflets while the next leaf and usually directly above it is 35 cm. long bearing seven pairs of broad leaflets.

In short, these nursery forest trees show that the foliage that was formed during the premature ripening period was very much smaller than the normal and was followed by a continuation of the same stems with leaves that were quite different in form but that as the twigs continued to thrive, the normal form was again approximated. The foliage in the portion of the stem most active during the checked and revived period was below the normal in size and the form changed materially with the first leaf upon the new growth, the chief distinction being the shortened axis and a broader equatorial diameter.

Plate XXI may help to bring to the eye some of the observations under consideration. At 1 is shown a privet twig cut close to the stem from which it grew laterally; some of the leaves had fallen, both at the base and at the middle portion which marks the retarded growth above mentioned, and the differences are evident only in a general way. It is seen that the internodes are shorter in the zone of retardation (2); in other words, there was in this way made a record of the checked growth which is also shown in the smaller leaves as the cessation point is approached from the base. With the renewed growth there was an increase in the length of the internodes but the first pair of leaves was small and one had fallen. It is further noted that the leaves of the later growth are larger and more pointed than the corresponding ones below the cessation point.

At 3 is shown a twig of Forsythia (*Forsythia viridissima* Lindl.) which admits of a clearer photograph than its relative the privet. The cessation zone is evident chiefly from the reduced size of the leaves. This species has its first leaves from a winter bud without further serration and this entire margin is evident in the small leaves that form first after growth is renewed, even with those of nearly normal size. All leaves have the lower third smooth-margined and apparently this is associated with the early growth of a bud that has prepared itself for a quiescent life and whether it is a result of vernation or food supply or both, along with other factors, remains for determination.

The pendulous Forsythia (*F. suspensa* Vohl.) is represented at 5, where only the middle portion of a ten-foot branch is shown. In this species the foliage is more variable than in the last, the compound type being quite common among the larger leaves situated, as a rule, in the more central portion of the year's growth. In the twig shown, there are three pairs of these compound leaves upon nearly equidistant nodes. The checked growth is recorded in the succeeding shorter internode and the pair of small leaves, one of them entirely simple and the other with the side leaflets greatly reduced. From this cessation point the internodes increase in length for a time. The leaves had fallen from two nodes (6), due to the unfavorable conditions induced—leaves that approach somewhat the nature of bud-scales are often short-lived—but the third pair is intact and each leaf shows an oval form, an entire margin, a slightly retuse tip, very different from the leaves below and above them. In many of the stems of this Forsythia, the compound leaves were developed after the rest period and apparently the full vigor of two months or so earlier had been restored. The size and complexity of a leaf in any given species like this one becomes an expression for conditions of growth, one always being mindful that internal forces play no negligible role in determining the size and form of the various parts and therefore under identical conditions plants of the same kind do not express the same results.

At 7 is a spray of English Ivy (*Hedera Helix* L.) in which the cessation zone is evident from the shorter internodes and the smaller leaves. Here the dwarfed leaves (8) are very broad without evident petioles followed by leaves with outline far less irregular than in the normal leaves on their long petioles shown below and above this zone.

So far as time would permit, this study of the effect of the midsummer drought has been extended into the nursery, orchard and forest with the result that whatever has been stated above and shown in the engraving is of general application.

In short, when hard times come on more or less gradually like the drought in question, plants are naturally checked in their growth and it is permanently recorded in ligneous plants in the shortened internodes even to the less enduring bud-scale scars, and for the passing season in simplified leaves that approach the type of the first upon a new branch and peculiar to the species in question.

It is drawn from the tables of measurements of sets of stems with their leaves that the last leaf formed before the temporary cessation has the shortest internode below it of any affected by the drought. Furthermore, the internodes below the shortest in regular order are longer until the normal is reached in the

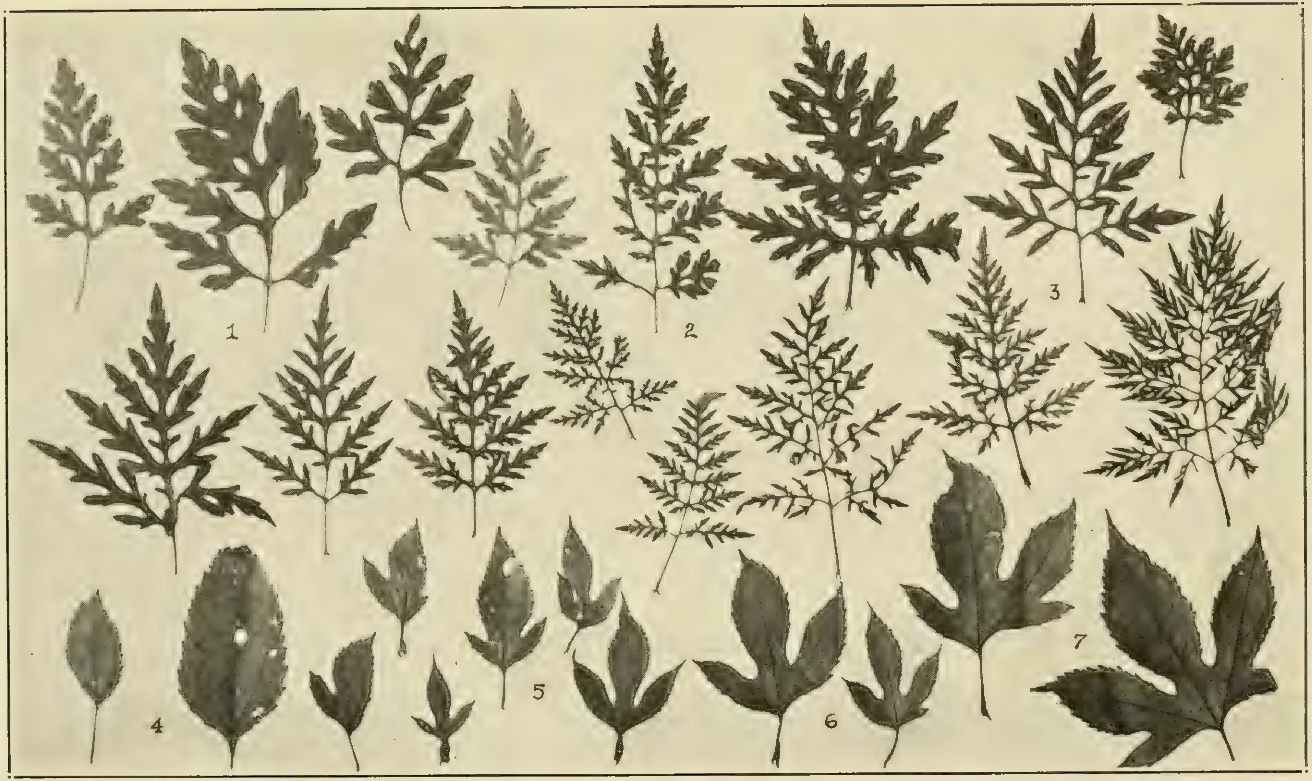


PLATE XXII. *Leaf Variation.* The upper portion (1, 2, 3) of the plate shows various forms of Common Ragweed, quite constant upon any given plant; from 4 to 7 are leaves from the same branch of the Giant Ragweed.

neighborhood of the fifth internode. On the other hand, the internodes of the resumed growth equally uniformly increase in length toward the growing tip until the normal is attained.

It is also determined that there is an absolute shortening of the petiole at the center of the disturbed area and an increase both up and down the stem. Relatively the petioles were not shortened when they are considered in connection with the size of the blades they bore.

The length and width measurements do not state accurately the areas of leaves but are convenient terms of comparison. From the tables, it is gathered that the foliage is checked more in length than in width growth.

Leaf Variation.

When one is studying the variations in vegetable-fruits, as the beans, eggplants, peppers, squashes and tomatoes, it is quite to the purpose to keep in mental touch with the forms that are exhibited by other plants that are either wild or being grown under widely differing conditions from those obtaining in the garden.

Below is a brief and incomplete record of some wayside studies of two acknowledged weeds, one indifferent plant of the pastures, and lastly an ornamental shrub that was close at hand.

LEAVES OF RAGWEEDS.

The Ragweed (*Ambrosia artemisiaefolia* L.) has handsome finely divided leaves and upon the same plant they are usually quite uniformly alike, so that one might well conclude that the foliage of this species exhibited no marked variation. But when one studies these plants, one with others as they grow in discouragingly large numbers almost everywhere, is is soon apparent that the variations are great. Thus, as a whole, some leaves are long and slender while others are broad and triangular. Very many have the tips of the many lobes broad and blunt (Plate XXII, 1), while others are acute (2 and 3). A study of a few of the numerous forms given in Plate XXII will serve to introduce the reader to the subject of leaf variation among the plants of the same species, as abundantly illustrated in a common wayside weed.

In *Ambrosia trifida* L., the "Great Ragweed," one finds the variation great upon the same branch, as illustrated in the set shown in the lower portion of plate XXII. The first leaves (4) here are of a very simple type, namely, oval-serrate; but shortly a tendency to become lobed (5) is met with usually upon one side that gives rise to a "mitten," so frequently found in the Sassafras. Other leaves may show lobation upon both sides (6), thus producing three divisions of the blade. Furthermore, the separation may continue until four, five (7), and very likely more lobes are produced. The samples of forms shown in the lower portion of Plate XXII are all from the same plant and no extended search was made for a longer series, the point being to show that with plants of the palmate type, there may be many degrees of lobation determined doubtless, in large part, by the number and position of the main veins and the position of the leaf upon the plant, its supply of nutrition, including soil and air conditions.

In these Ambrosias it is noted that one species, as previously stated, has comparatively constant foliage for the same plant but exhibits a striking variation in the species. Somewhat contrariwise, the second Ragweed has a very wide range of leaf forms upon the same branch. The difference in this regard may be due to the type of leaf where lobation means much to the eye in one and not in the other.

THE GREEN MILKWEED.

The Green Milkweed (*Acerates viridiflora* Eaton) is somewhat common upon the dry knolls in the vicinity of the Experiment Station, and for years has been a subject for casual observation as regards, in particular, the constancy of the leaves upon any single plant and the great variation when the plants as a whole are considered.

In September last one hundred plants, all bearing maturing pods, were cut close to the ground and at random upon the same morning over an area of near five acres. The following points were tabulated: (1) height and (2) color of plant, (3) number of pairs of leaves, (4) their length, (5) breadth and (6) shape of tip, (7) number and (8) size of pods.

The following table shows the height of the plants:

Centimetres..	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Instances....	1	3	1	1	2	2	2	0	4	4	6	2	4	4	4	4	5	2	4

Centimetres..	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	57	60	73
Instances....	1	2	7	3	3	4	5	4	1	1	1	2	3	1	3	2	1	1

There is no one norm around which the heights are grouped, that is, from 30 to 48 cm. the variation is quite within the range of expectation for so few instances.

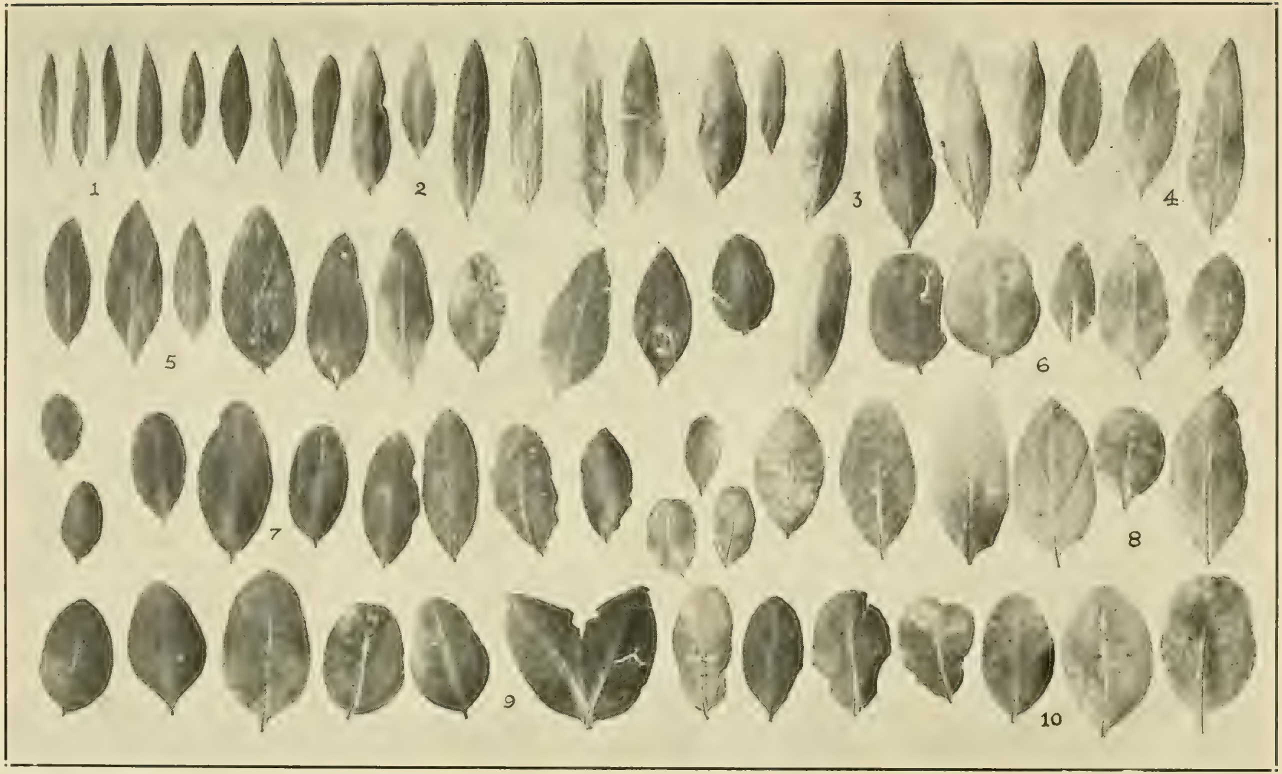


PLATE XXIII. *Leaf Variation.* Seventy leaves of Green Milkweed—one from a plant—are shown to illustrate the intergrading of forms from the long type at 1 to the oval at 10.

In the matter of color there were seven plants distinctly purple in stem, leaf and pod, and 29 in which the color, sometimes quite pale, was confined to the pods. In other words, there were 36 with color to 64 of the plain green type.

The pair of leaves per stem ranged as follows:

Number of pairs	7	8	9	10	11	12	13	14	15	16
Instances	2	6	12	21	15	20	13	8	2	1

There is an unexpected small number for the 11 pairs which should be 25 instead of 15 when the series is considered mathematically.

The length of leaves is expressed in the following scheme:

Centimetres	4.3–5	5–6	6–7	7–8	8–9	9–10	10–11	11
Instances	6	17	33	28	10	4	1	1

In a similar way, the breadth of the same set of leaves is given below:

Centimetres	1–2	2–3	3–4	4–5	5–6	6
Instances	10	31	40	15	3	1

The leaf was quite distinctly flat in 61 instances and wavy in 39; and the tips were blunt, occasionally retuse in 77 leaves and pointed in 23 cases.

In length, the pods (follicle) varied greatly and in a general way may be grouped under long, 20; medium, 37; and short, 43; while in number upon the stem, they were as follows:

Number of pods	1	2	3	4
Instances	41	39	16	4

Plate XXIII shows 70 leaves of the Green Milkweed from as many plants taken at random, not included in the above one-hundred, and arranged somewhat in a series from the narrowest to the broadest in four rows from left to right.

Dr. Gray records two varieties for *Acerates viridiflora,* namely, var. *lanceolata* Torr. (*A. lanceolata* Ives) and var. *linearis,* a western form, Minnesota to New Mexico, which does not seem to need attention here. Britton and Brown recognize *A. viridiflora Ivesii* as the variety of the eastern range with the lanceolate or oblong-lanceolate leaves. In the present study, it would seem that through crossing, etc., the species and its recorded variety are so intergraded as to make the latter of little botanical value.

LEAVES OF DROOPING FORSYTHIA.

A single plant of the Drooping Forsythia (*F. suspensa* var. *Fortunei*), growing near the Experiment Station has been a subject of study concerning its forms of leaves. The normal leaf may be assumed as simple ovate, somewhat lanceolate and evenly serrate excepting near the base, where it is entire. The smaller leaves (shown at 1, in Plate XXIV), especially those located near the base of a branch, are entire throughout the whole margin and such leaves are ovate and even obovate and therefore with a blunt apex. · The largest leaves (6), as a rule, are trifoliate, the terminal leaflet often exceeding the size of the largest simple ones and having, in addition, a pair of comparatively small leaflets below. Various gradations between the simple and compound leaf may be met with upon the same long drooping branch (3 to 6). Frequently there is only a single minute leaflet as if separated from the other portion of the blade by a curved cut of the scissors (3). Other leaves show two of these separated parts forming a pair of ear-like appendages just below the main portion (5). Often these secondary leaflets are ovate and entire, but in the largest ones the three leaflets are generally alike in shape with serrate margins and quite widely separated but the additional pair is always comparatively small. One wishing to study the variation in shape of the simple leaves and the development of the compound type may find Plate XXIV of interest, where the seventy-five leaves from the same plant show minor variations; in fact, there are no two leaves that match perfectly.

WEATHER NOTES FOR THE GROWING SEASON.

Upon page 274 is given a table of the rainfall during the growing season, April 1st to October 1st, for the whole State for the past twenty-two years. The season just closed has been the third driest in that period, being exceeded only by 1895 and 1899. The last July broke the record for shortage in rainfall, it being only 1.36 inch and the normal, 4.83 inches. This was followed by a dry August and September, and May was also far below the average in precipitation.

Upon page 275 is the record of the temperatures of the State for the corresponding six months and it is shown that they rank as near to the average as possible, that is, twelfth for warmth and eleventh for coolness out of the twenty-two years under record.

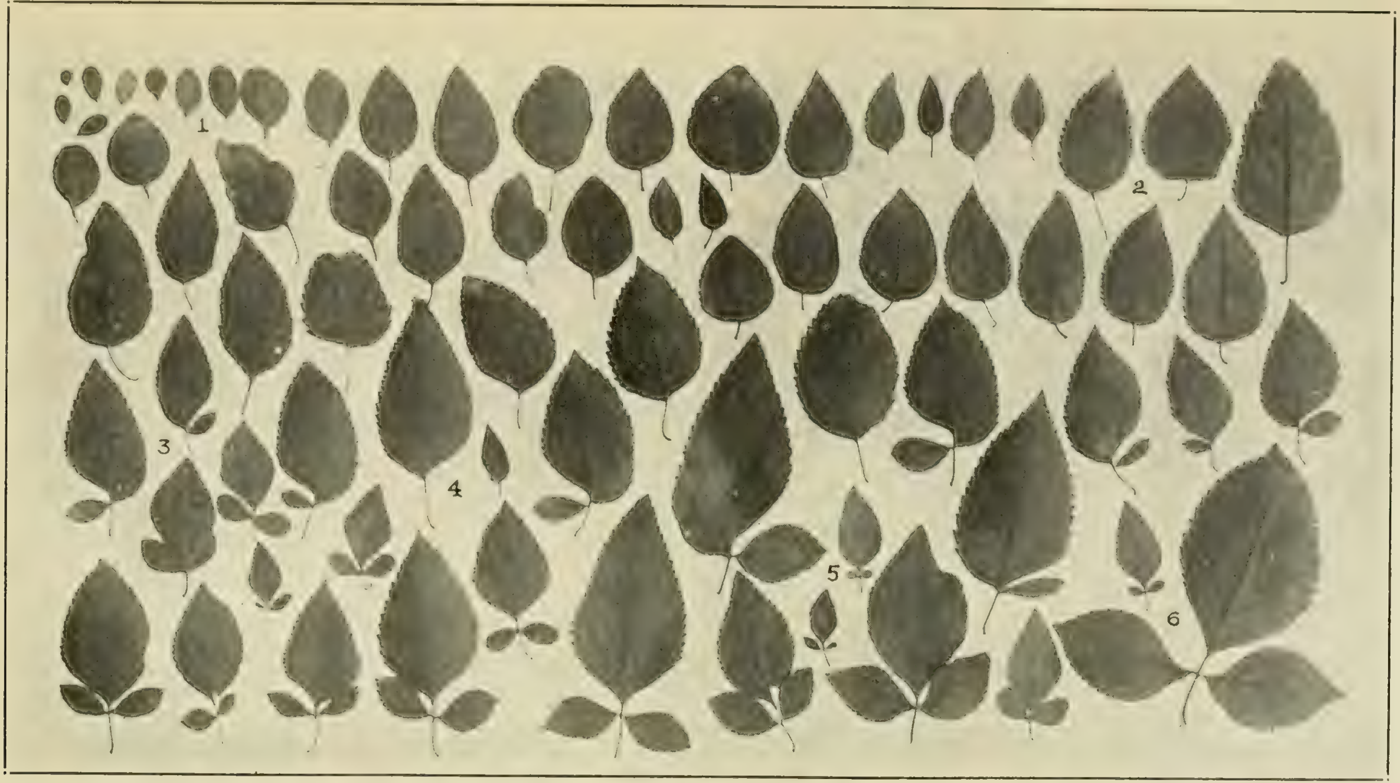


PLATE XXIV. *Leaf Variation.* Seventy-five leaves from the same Drooping Forsythia plant are shown to illustrate the remarkable diversification of forms.

The table for sunshine upon page 276 shows that the past growing season was unusually dark and quite similar in this regard for the preceding one.

As a whole, the season was remarkable for a dry, hot, clear July with the lack of rainfall extending through August and September and altogether a severe one for truck crops.

Rainfall of the Growing Season for Past Twenty-two Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	Average.
April........	5.32	2.65	2.19	2.49	5.21	3.09	4.88	1.35	3.79	3.74	1.73	2.29	6.31	3.62	3.97	3.43	2.88	3.64	3.78	2.72	5.97	5.34	3.65
May.........	4.09	4.24	2.97	5.04	4.07	7.72	2.85	3.21	5.68	7.00	1.92	4.71	5.60	2.04	0.59	2.60	1.71	4.21	5.05	7.10	2.30	2.54	3.97
June.........	3.73	3.59	2.92	3.85	2.95	2.28	3.24	5.46	3.38	2.10	2.50	3.08	1.57	6.57	7.68	3.13	3.43	4.48	4.41	2.32	3.26	5.17	3.69
July.........	10.19	5.62	5.30	4.03	2.72	1.66	4.26	5.50	11.42	4.96	5.75	4.74	5.87	4.78	5.51	4.87	4.06	5.58	2.62	4.70	2.12	1.36	4.89
August.......	5.18	4,90	5.32	3.63	6.52	2.58	1.83	4.39	5.36	4.36	2.68	9.43	3.91	6.95	6.95	6.62	5.72	5.95	3.45	5.05	4.57	3.78	4.95
September....	8.36	4.75	2.46	1.81	3.30	7.46	1.07	4.37	1.65	2.00	5.88	2.86	3.38	5.65	3.34	4.79	5.23	2.19	8.08	2.09	3.30	2.39	3.93
Totals....	36.87	25.75	21.16	20.85	24.77	24.79	18.13	24.28	31.28	24.16	20.46	27.11	26.64	29.61	28.04	25.44	23.03	26.05	27.39	23.98	21.57	20.58	25.08
Average..	6.14	4.29	3.53	3.47	4.13	4.13	3.02	4.05	5.21	4.03	3.41	4.52	4.44	4.93	4.67	4.24	3.84	4.34	4.56	4.00	3.59	3.43	4.18
Rank in wetness......	1	9	18	19	12	11	22	13	2	14	21	6	7	3	4	10	16	8	5	15	17	20	
Rank in dryness......	22	14	5	4	11	12	1	10	21	9	2	17	16	20	19	13	7	15	18	8	6	3	

Temperature of the Growing Season for Past Twenty-two Years.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	Average.
April........	51.2	50.4	52.0	49.3	49.2	50.3	49.1	52.4	50.4	47.8	49.9	50.8	48.3	50.2	50.9	46.7	49.9	51.2	45.2	51.2	50.2	53.5	50.1
May........	62.3	60.7	59.5	60.1	59.4	61.4	60.9	65.3	60.6	58.5	61.1	60.9	58.6	60.3	62.7	62.8	61.4	61.0	55.4	61.6	60.0	60.0	60.7
June........	69.9	70.7	69.7	72.4	69.7	70.6	71.7	68.1	66.1	70.1	72.3	70.4	70.0	67.5	64.0	68.6	68.3	70.4	64.7	69.9	70.0	66.9	69.2
July........	73.4	72.5	70.1	74.3	73.9	75.7	70.9	75.0	74.1	75.3	74.7	75.9	77.3	73.0	73.3	72.3	74.4	72.8	73.6	75.6	71.6	75.3	73.9
August......	69.6	71.5	72.8	73.4	72.8	70.9	74.2	73.6	71.0	74.8	72.3	76.3	73.8	70.1	68.4	70.8	71.1	74.6	70.5	70.6	70.2	70.4	72.0
September...	64.8	64.4	68.7	64.2	62.7	68.3	69.7	65.1	65.5	68.6	64.4	69.9	66.8	64.6	65.0	64.8	65.4	68.9	67.1	65.7	64.5	67.3	66.1
Average...	65.2	65.0	65.4	65.6	64.6	66.2	66.1	66.6	64.6	65.9	65.8	67.4	65.8	64.3	64.0	64.3	65.1	66.5	62.7	65.8	64.4	65.6	65.3
Rank in Warmth.. .	13	15	11	10	16	4	5	2	17	6	7	1	8	19	21	20	14	3	22	9	18	12	
Rank in Coldness.......	10	8	12	13	7	19	18	21	6	17	16	22	5	4	2	3	9	20	1	14	5	11	

Sunshine of the Growing Season for the Past Twenty-two Years in Percentage of Clear-Partly-Cloudy Days.

	1889.	1890.	1891.	1892.	1893.	1893.	1894.	1895.	1896.	1897.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	Average.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
April......	53	76	80	53	60	70	60	76	83	62	87	77	50	70	66	70	77	83	67	77	70	67	69.9
May.......	65	66	64	71	69	65	78	71	78	52	77	75	58	84	84	84	74	77	68	61	68	65	70.6
June.......	66	80	76	76	70	83	73	73	80	87	84	80	87	83	53	77	77	73	73	93	63	63	75.7
July.......	58	76	69	84	87	84	78	74	68	74	77	87	71	71	84	74	81	81	64	81	75	77	76.0
August.....	74	77	61	78	81	80	90	87	84	77	71	84	71	90	65	81	74	68	84	65	65	61	76.7
September..	53	66	83	87	73	66	90	70	87	83	80	80	80	60	83	80	76	80	60	63	60	73	74.3
Average..	61.5	73.5	72.2	74.8	73.3	74.7	78.2	75.2	80.0	72.5	79.3	80.5	69.5	76.3	72.5	77.7	76.5	77.0	69.3	73.3	66.8	66.7	73.9
Rank in Brightness	22	12	17	10	13	11	4	9	2	15	3	1	18	8	16	5	7	6	19	14	20	21	
Rank in Darkness.....	1	11	6	13	10	12	19	14	21	8	20	22	5	15	7	18	16	17	4	9	3	2	

Inheritance Studies With Beans.

EARLE J. OWEN, M. SC.

In Series VII, Plots 2 and 3 selected, white seeded bush limas were grown of the "J. W.-Dreer" set; two-thirds of Strip I included the "J. W." * crosses ("J. W. type," "Dark-red," "White"), also the "Station Bush" and a few pole limas. The "Scarlet Runner" hybrids, commercial Snap Beans, selected bush crosses and "J. W.-Dreer" (white) occupied Strip II.

SNAP BEAN CROSSES.

The selected strains of Station Snap Beans, No. 1 (131/130), No. 2 (26/29), and No. 3 (129/111) were under observation and kept well to type. Station No. 3, all points considered, seems most desirable. Frequent pickings of the "Snaps" for table test kept the plants in bearing until checked by frost, and the brittle pods were marketable when nearly mature.

"PRESIDENT ROOSEVELT"—"CRYSTAL WAX"—"DAVIS" (243//145/112) III.

This cross is of interest in that it represents the union of a stringless, white seeded, green podded pole bean with a white seeded, stringless, wax bush bean.

The plants of the first generation produced runners freely and yielded green pods containing white seeds. No plants of the second generation were strictly "polers" but possessed well-developed runners in most instances, while the pods were of four colors—yellow, white, pale green and green. The pods produced this season are quite uniformly stringless and of fair size, the 225 plants grown yielding fruit divided among the four colors as follows:—yellow, 108; white, 47; pale green, 13; green, 57.

"LONGFELLOW"—KEENEY'S REFUGEE" (26/132) II.

This represents a cross between two mottled varieties with the idea of determining as to whether a solid color ever results from such a union. All plants of the first generation produced mottled seed and the thirty plants grown this year all yielded a mottled purple seed resembling 132.

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*"J. W." stands for "Jackson Wonder," a speckled bush lima bean.

"CRYSTAL WAX"—"MARKET WAX" (145/135) V.

But one selected type of this cross was grown, the strain resembling 135 in color. The record at harvest time showed 79.16 per cent. of theplants with seeds similar to those of the parent.

GOVERNMENT NOVELTIES IN BEANS.

23755. The plants were rank growers with spreading habit, blooming late. The flowers were pink, borne in clusters of three or more. The pods were green, flat, and late in maturing.

23756. The plant habit was similar to the above with dark green foliage. The white flowers were borne in pairs. The late green pods were flat, curved, and stringy.

23763. The plants of this sort were inclined to run, were late in season, bore pink blooms, and produced light green, curved, flat, stringy pods.

23791. This proved to be another "spreading" variety with late season, bearing white flowers in clusters of three or more. The pods were green.

23805. Like the above, late in season and spreading in habit, with pink flowers and long flat green pods.

23829. These plants produced runners with a foliage of small leaves, light green in color. The small white flowers were in clusters of three or more. An occasional bush plant, with earlier maturity, was found among them.

24215. These plants with habits similar to the six preceding sorts had a light green foliage, bore pink flowers and, in many instances, flat wax pods were produced.

"JACKSON WONDER" CROSSES.

The accompanying table, which is a comparison of this season's results with those of 1908 and 1909, represents in brief a continuation of the work on color inheritance, selection being restricted to the three principal color types known as "Jackson Wonder" ("J. W."), "Dark-red" and "White."

Under the percentages for "J. W." type, "J. W.-Henderson" stands highest in the set for each year, showing .2 per cent less than in 1908 and 10.1 per cent. more than in 1909.

Referring to the "Dark-red" strains, "J. W.-Woods" leads for the two preceding years, but has fallen below for 1910; and "J. W.-Willow-leaf" takes first place, an advance of 7.4 per cent since 1908. Regarding the "White" strains, all stand high this season, but none reached the standard (100 per cent.)

Comparing the average percentages for the three years, those for "J. W." and "White" were lowered in 1909 but all have been raised since, "J. W." alone being .9 per cent. less than in 1908.

One hundred fifty-one plants of "Jackson Wonder," selected dark, were grown this season, 91.8 per cent. breeding true as against 85 per cent. the year previous, which points to its fixation by means of simple selection.

Color of seed parent.	Cross used	Number of plants grown.			Per cent. breeding true.		
		1908.	1909.	1910.	1908.	1909.	1910.
"Jackson Wonder."	"J. W.—Burpee."	84	52	100	98.8	69.2	84.
" "	" " –Dreer."	37	20	96	67.5	65.	81.2
" "	" " –Henderson."	123	27	97	99.1	88.8	98.9
" "	" " –Woods."	41	33	163	65.8	63.6	77.8
" "	" " –Station Bush"	94	20	126	74.4	73.	59.5
"Dark-red."	" " Burpee"	30	76	209	50.	85.	69.8
" "	" " .Dreer"	193	77	56	59.8	50.6	75.
" "	" " –Willow-leaf"	167	78	149	77.8	66.6	85.2
" "	" " –Woods"	101	87	170	90.	96.5	84.7
" "	" " –Station Bush"	240	80	154	66.5	50.	81.1
"White."	" " –Dreer"	41	414	1,138	97.5	78.	97.1
"	" " –Henderson"	290	26	109	98.6	92.3	97.2
"	" " –Willow-leaf"	164	26	145	97.8	100.	97.9
"	" " –Woods."	481	32	180	96.2	96.8	98.8
"	" " –Station Bush"	92	30	38	85.5	100.	94.7
Total average for "Jackson Wonder"					81.1	71.9	80.2
" " " "Dark-red"					68.8	69.7	79.1
" " " "White"					95.1	93.4	97.1

"STATION BUSH" LIMAS.

The two strains of "Station Bush" Lima ("Flat" and "Plump") were continued, producing plants, pods and seeds as uniform as any commercial variety.

"SPECKLED LIMA—WILLOW-LEAF POLE," III.

From the planting of the new mottled red seed found at harvest time, 1909, some interesting beans have resulted. One, a solid dark red, resembles the color in the "J. W." crosses;

while another, "pale-gray," is nearly white with a yellow ring around the eye. The "mottled-brown" and "white" strains were also grown, each giving a few plants with colored seeds.

Last year it was noted that the "mottled-red" seed of this cross was associated with a purplish stemmed plant, which character reappeared this season in several individuals and seems to be associated with a colored seed.

Strangely, no "willow-leaved" plants have appeared during three successive generations, although there is no doubt that the mother parent was a "willow-leaved" pole. This cross is of interest in comparison with the results obtained in the "J. W." crosses. It is seen that similar bean markings are coming to the surface and the "Lighter-red" may appear later, since the "Dark-red" has been dormant for two generations.

"SCARLET RUNNER" HYBRID.

Plate XXV represents, together with the parents on either side, the yield from a single plant of the hybrid, "Scarlet Runner-Tennessee" (63/43) B-4-2-2, the seed at hand beginning the fifth generation.

In the Annual Report, 1909, p. 339, the immediate parent is recorded as having "rose-pink" flowers and "light-gray mottled" seed. The large beans at the left (1) stand for the male (63), and those at the right (3) for the female parent (43). A discussion of these two species may be found on page 338 of the same Report.

The plant whose seed occupies the center (2) of the plate was spreading in habit and of wonderful vigor, being late in season and bearing 261 flat green pods with a total product of 908 seeds or 3.4 per pod. This is an unusually heavy yield when one considers that thirty pods are a good average for a snap bean.

As to form and size, the seed of the cross pictured above favors the male parent; but the markings, while bearing a resemblance to the selected parent type (B-4), are heavier and darker with a peculiar "striping" not found in the "light gray mottled" strain.

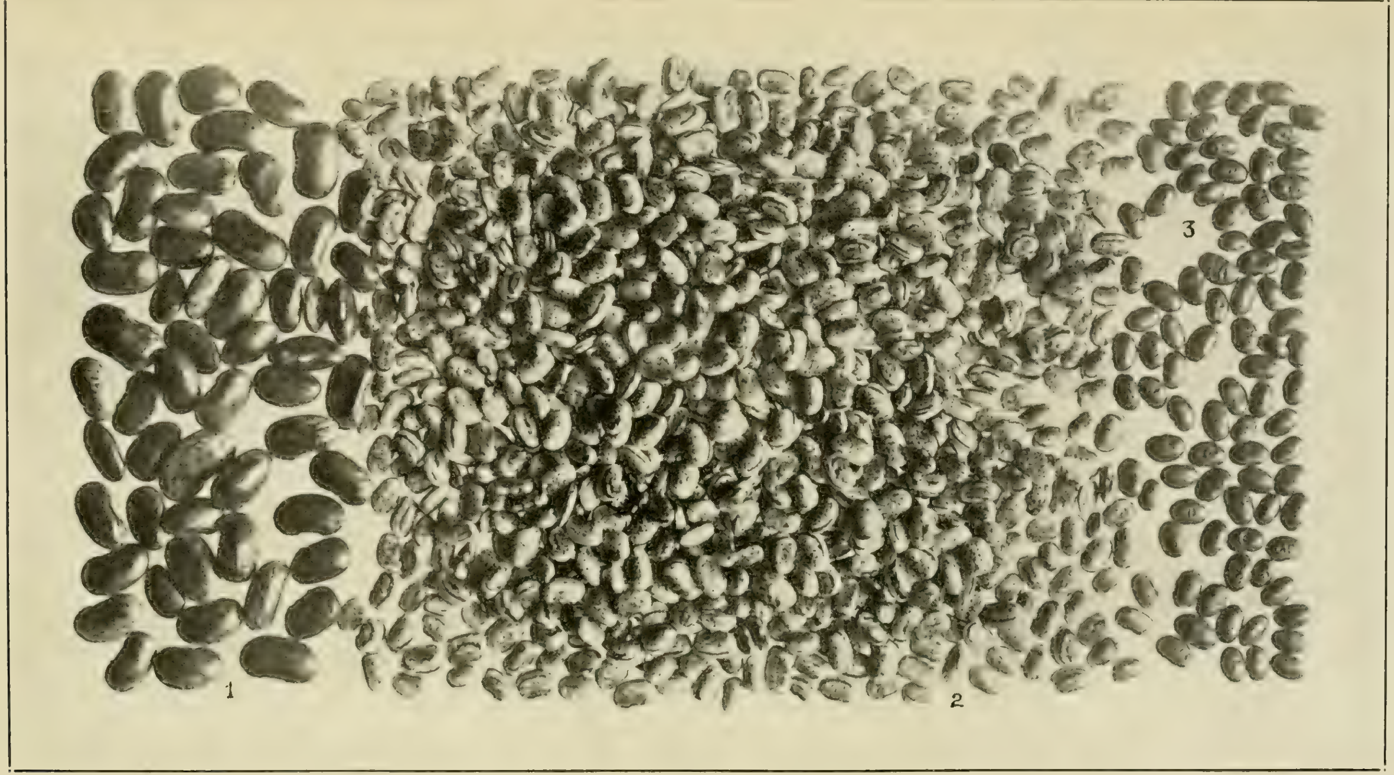


PLATE XXV. *Hybrid Beans.* Seeds of the "Scarlet Runner" are shown at 1, and of "Tennessee Bush" at 3, with the crop of a single hybrid plant of the two between them (2)—261 pods and 908 seeds.

Strain.	Number of plants.	Plant habit.	Chief flower color.	Chief pod color.	Per cent. true to seed color.
"Light gray mottled."	49	Spreading bush.	Salmon-pink	Green	77.5
"Dark-brown."	30	Tall bush.	Shades of pink.	"	63.3
"Mottled."	23	Bush.	White-pink.	"	46.05
"Brown."	35	"	Pink.	"	71.4
"Mottled-brown."	52	"	White.	Yellow.	40.3
"Black."	18	"	Salmon-pink.	Green.	67.8
"White."	100	"	White.	"	80.03
"Red."	14	"	Salmon-pink.	Yellow.	83.3

Referring to the table above, it is seen that the bush form of plant predominates, showing the result of selection for that type, since "polers" and "runners" have been discarded in most instances. The term "Chief flower color" indicates the one most in evidence when the notes were taken. The so-called "Salmon-pink" is not yet established, as it is not always correlated with the "Light-gray mottled" seed. In fact it is found in union with all the darker bean colors, being absent only in the case of plants yielding white seeds.

The green podded plants are far in excess of the yellow, and, in certain instances, the yellow pod is breeding true.

As to seed color inheritance, "White," "Red," and "Light gray mottled" show the highest percentages. "Dark-brown" and "Brown" show a difference of but 8 per cent. and might be classed together, while the same could be said of "Mottled-brown" and "Mottled," the former breeding 6 per cent. lower than the latter.

From a commercial standpoint, B-12-2-1-8 is perhaps the most interesting strain, the large stocky bush plants bearing good sized, flat yellow pods (average 81.1 pods per plant), which yield white seeds about the size of the "White Kidney Field" and are equal to that variety in table quality.

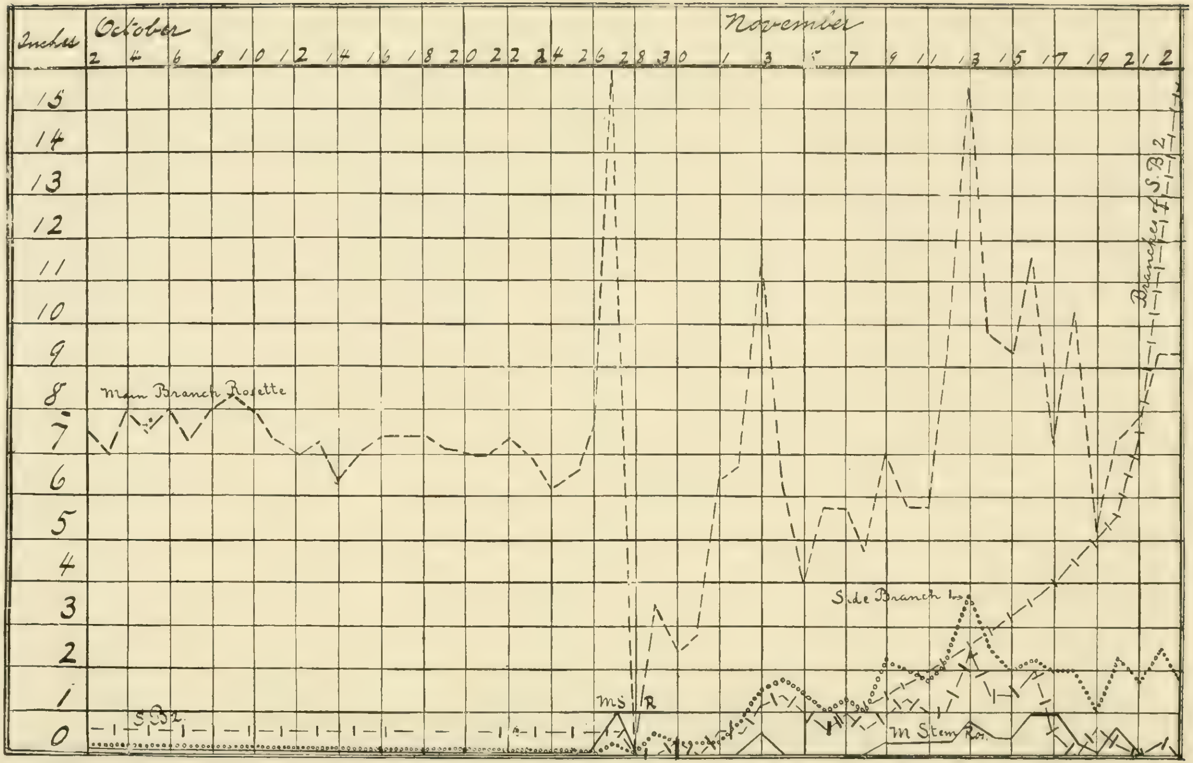
Inches
October
November
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
1 3 5 7 9 11 13 15 17 19 21
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Main Branch Rosette
S.B.2.
MS
R
Side Branch Ros.
M Stem Ros.
Branches of S.B.2

PLATE XXVI.

Contribution to the Study of Circulation.

Studies on the Sweet Potato (*Ipomœa batatas.*)

B. H. A. GROTH, PH. D.

The preliminary report on this investigation, published in the Annual Report for 1909, recorded the progress of the experiment from July 2nd until October 20th, 1909. A sweet potato vine was planted in a box and its "Main Stem (M. S.)" and "Main Branch (M. B.)" potted at regular intervals in pots numbered 1, 2, 3, etc. and A, B, C. etc., respectively. After August 15th all water was withheld from the box and the pots 1, 2, A and B, and the effect of the partly reversed water current upon the growth of the entire plant recorded. It was brought out that the immediate effect was a sudden decrease in the rate of growth on all parts of the plant, followed by a period of great instability lasting for 39 days, and the establishment of an equilibrium with a rate of growth lower than the original. (See Ann. Rep. 1909, Plates XXVI and XXVII).

On October 25th, 1909, after the plant had grown with a partly reversed water current for 71 days, the plant was in the following condition: The M. S. and its rosette (M. S. R.) had practically stopped growth; all branches along the M. S. had ceased to grow, and those between the box and pot 4 had dried back to two internodes. The M. B. Rosette was growing at a rate of 7.5 inches a day; all branches between the box and pot 3 had dried back to two internodes or less, with the exception of the two branches S. B. 1 and S. B. 2 between the box and pot A. These were growing at a steady rate of about 0.5 inch a day. The curves for these rates of growth appear on the left half of Plate XXVI. Some roots in the box had first slightly decreased and then slightly increased in circumference.

On October 25 all dry parts were again supplied with water, like the rest of the plant. The curves on Plate XXVI show the result as follows:

MAIN BRANCH AND ROSETTE.

The curve, rather balanced before October 26, becomes erratic on that date, and is particularly marked by a sudden rise to 16 inches, followed the next day by an abrupt fall to 0, from which it rises jerkily to a higher level. Unfortunately trouble with the furnace after November 20 occasioned several cold nights which made observations after that date unreliable. From the general direction of the curve it seems as if the future level, after an equilibrium would be reached, were to be higher than the original.

One of the branches springing from the M. B. at pot B, which had dried down to two internodes, renewed growth from the axil of the second leaf (which had fallen) and produced its first leaf on November 4, the second on November 22, the third on December 7.

MAIN STEM AND ROSETTE.

Growth had decreased so much that it was no longer measurable daily. On October 26 the curve for its rate jumped to 1 inch, dropped to 0 on the next day, and maintained an average elevation of about .5 inch for the rest of the period of observation. It shows a vacillation similar to the previous curve.

One of the branches springing from the M. S. at pot 3, which had died down to two internodes and dropped its leaves, renewed growth from the second leaf axil, opening its first leaf on November 22, the second on December 7.

SIDE BRANCHES 1 AND 2.

In both of these branches the rate of growth was less than 0.5 inches a day and constant, showing gradual decrease. On October 26 the curve for S. B. 2 was not noticeably affected, while that for S. B. 1 showed a sudden rise. Both dropped to 0 on October 27 and rose in a jerky manner after that date, very similar to the curve for M. B. R. All three of these curves reached their successive maxima at exactly or nearly the same date. The curve for S. B. 1 did not reach the former low level again, while that for S. B. 2 did so only after a number of branches from near its tip had started out to grow at a rapidly increasing rate, reaching 15.5 inches by November 23.

The effect upon the curve of rate of growth by a reversal of the water current and a subsequent re-establishment of the old current may then be demonstrated by a diagram like this:

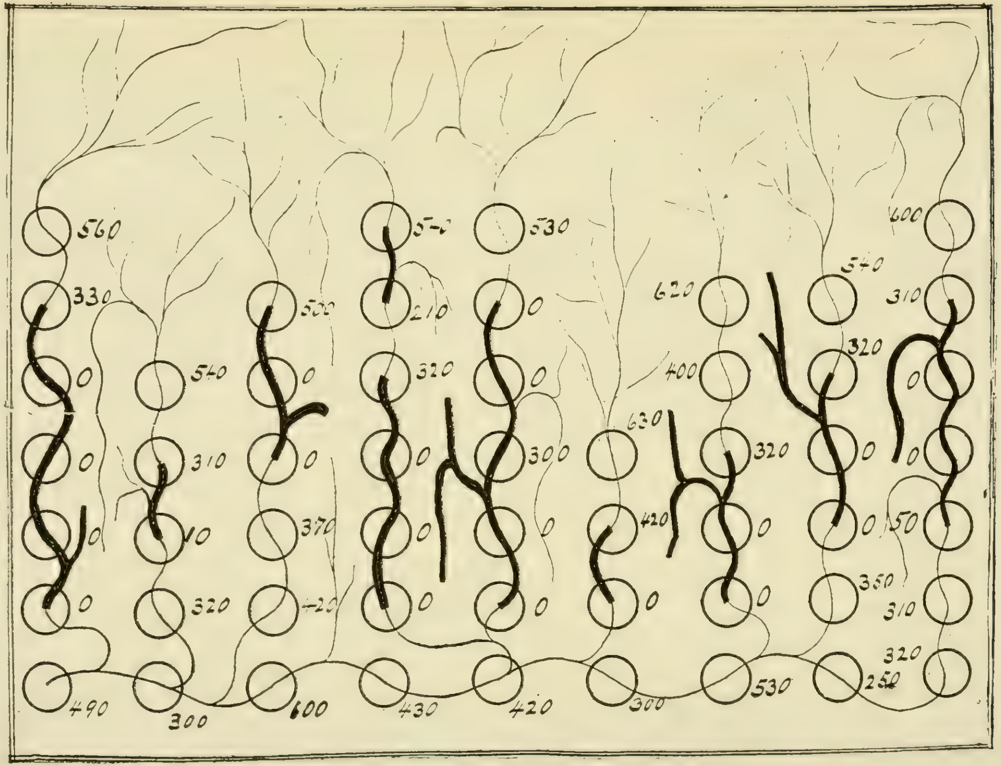
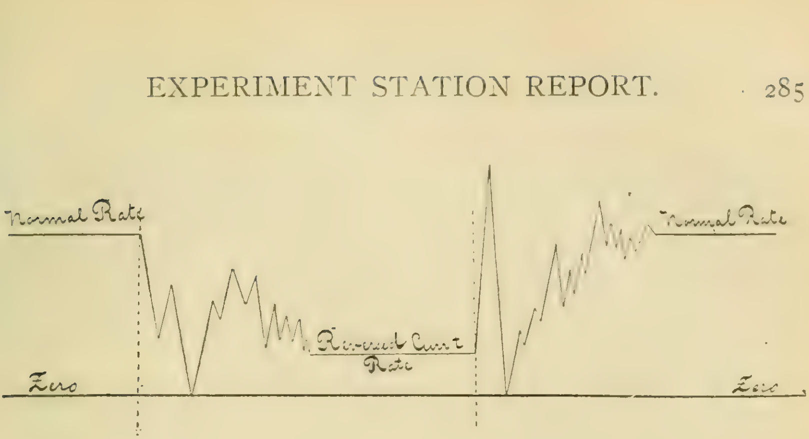

5-0
-20

Plate XXVII.



On account of the much less favorable conditions of heat and light after October 25, it could not be expected that the rates prevailing before August 15 would be resumed, and the M. S., dormant since August 30, indeed falls short of it. That both the S. B. 1 and S. B. 2 should approach it or even surpass it, with the drawback of feeding a set of young branches besides, and that the dried up branches in pots 3 and B should renew their activity, is indeed a striking demonstration of the fact that the normal direction of the water current allows the plant a much more rapid growth than the reversed current.

The roots under observation in the box showed no increase in circumference after October 25. They developed a rot on November 17 at the place where the raphia bands were tied, which severed them from the stem. New roots were subsequently formed.

Another investigation, with the object of tracing the movement of reserve starch in the circulation of a many-rooted sweet potato plant was begun on June 11, 1910. A branch, about 18 feet long, of the original sweet potato plant of the previous experiment, was rooted at intervals of approximately 18 inches in 10 inch pots, and given the best conditions in the greenhouse for rapid growth. All larger branches springing from any part of the vine were potted at intervals like the main stem, until August 5, when no more nodes were rooted. The plant then presented an appearance indicated by the diagram in Plate XXVII, except that the long branches emerging from the final pots had not then developed, and that there were many short branches not marked in the diagram. Several of the older pots were then examined, and no storage roots were found.

Leaves were then removed from some portions between rooted nodes. (The defoliated parts are designated in the diagram by very thick lines.) As will be seen, in most cases all leaves were removed while in others the leaves were left on some side branch springing off between pots. Up to four successive portions were thus defoliated on the same branch. After that, all pots received the same care, except that prospective branches from defoliated portions were nipped in the bud.

On November 15 all pots were emptied, and the roots roughly weighed to 10 grams. As the nodes were rooted at various times, the amounts found under each are of course not comparable with each other; but they are all comparable with the yields of the nodes near which portions of the stem had been totally or partially defoliated. The figures on Plate XXVII give the total yield in grams found in each pot.

It will be noted at once that no pot which had a piece of totally defoliated vine distal to it, contained any roots; all pots having some leafy branches distal to them contained some roots; those pots having the largest amount of foliage distal to them contained the largest amount of roots, although most of them were rooted latest of all.

This shows that the storage starch in a sweet potato plant with the normal direction of the water current is intercepted in its course by the first roots basal to the leaf from where is starts, and does not go beyond it.

The bearing of the results of these two experiments upon practice in sweet potato cultivation is evident. They show us that—*first,* any portion of a many rooted sweet potato plant may draw water from the roots most favorably situated. The roots so situated are those under the main plant, in the hill. So whenever a drought occurs, the rooted branches at any distance, will draw water from the main hill. *Second,* every rooted joint of any branch intercepts all the starch brought from all the leaves beyond it and allows none to pass to the main hill. Thus in dry time a rooted branch may feed upon the main root, but in the best growing time it does not help the crop of the main plant in the least.

The conclusion is of course, that it is necessary to prevent rooting of the branches to produce the largest crop in the main hill. Very likely the total yield would be largest where all joints are allowed to root, but most of these joints would then not have time to produce marketable roots. Where there is a very long growing season it might even prove profitable to allow some of the earlier branches to root.

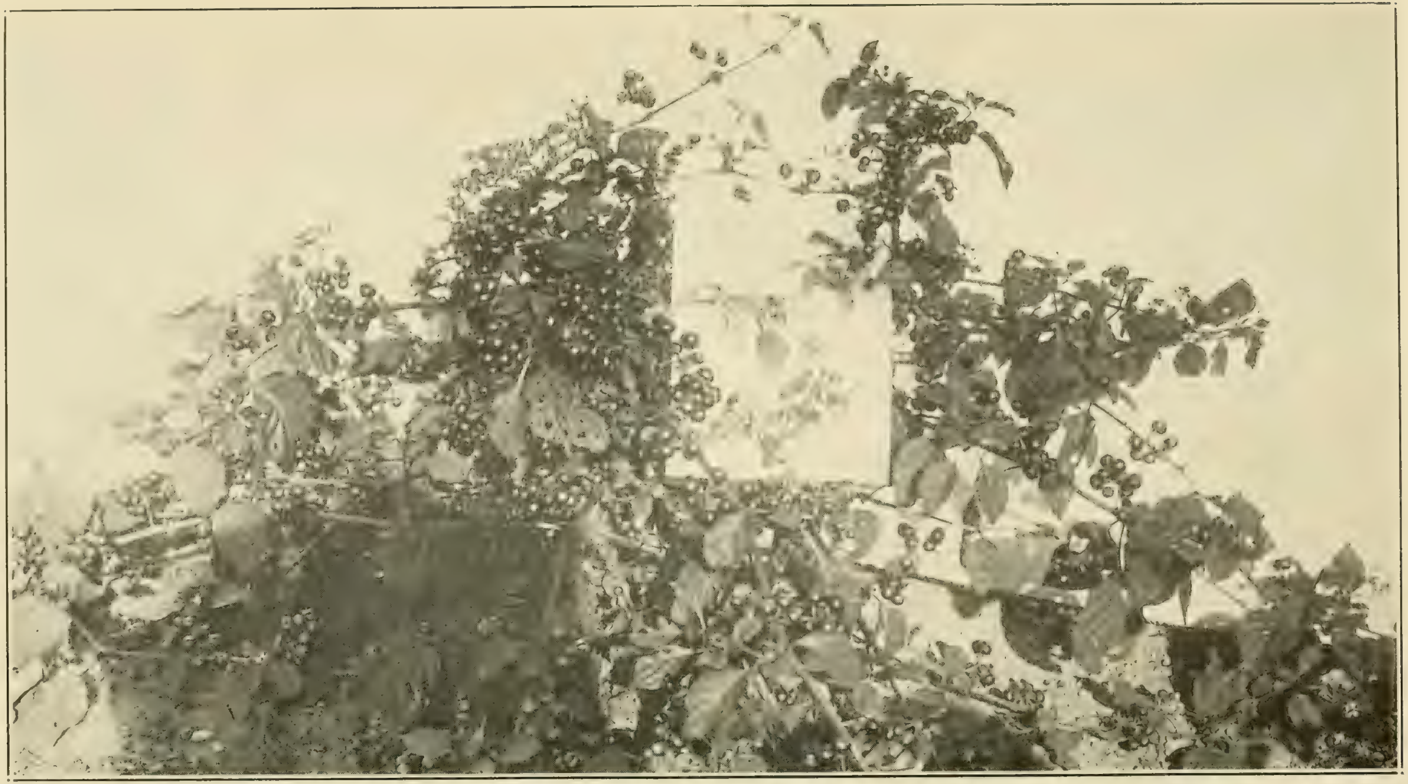


Plate XXVIII. *Prairie Berry.* (Garden Huckleberry.) On the sheet of paper is shown a branch of the "Wonderberry" with which it is often confounded. Note the difference in the size of fruit.

Cell-Number in the Fruit of the Prairie Berry.

A Study of the Heredity of Fluctuation.

B. H. A. GROTH, PH. D.

The Prairie Berry (also called Prairie Huckleberry, Garden Huckleberry) is a wild and cultivated large variety of the Black Nightshade (*Solanum nigrum* L.) It was introduced to this station from Prof. N. E. Hanson, of the South Dakota Station, some years ago. Like other species of the genus Solanum, it shows fluctuation in the number of cells of the fruit, and previous to 1909 an effort had been made at this station to increase by selection the size of fruit and number of cells, as the berries, though not edible when raw, make a very palatable preserve. (See Plate XXVIII.)

At the decease of Mr. Shore the work with the prairie berry was turned over to the writer. It was soon noted that the fruits of this plant appear to hold an intermediate position in respect to cell number, between the black nightshade, which is largely 2-celled with only occasional 3- and 4-celled fruits, and the tomato, which has distinct types, some of which are almost regularly 2-celled, other 2- to 4-celled, others many-celled. Among the many-celled tomatoes the "Ponderosa" types have the flowers and fruits distinguished by a marked fasciation. The corolla and calyx are many-lobed, the style is flattened, and the ovary cut up into many cells seemingly without order. It is known that the character of fruit fasciation has become fixed within recent times, and it is therefore very probable that the same process might be observed in a nearly related plant, as the Prairie Berry.

Among plants raised in the greenhouse from a close-fertilized six-celled fruit, one plant, which had been given special care, produced a single fasciated fruit of 8 cells, which was harvested in the fall of 1909. From the seeds of this fruit all Prairie Berry plants discussed in this paper have descended.

Some of the seeds were planted in the greenhouse in a box 1x2 ft. x 1 ft. high filled with very rich soil and given the best of care. At the age of 10 days only the one strongest seedling was retained and all others destroyed. This remaining plant was called *Plant* 1.

PLANT 1 developed into a large plant. As soon as the roots began to fill the original box, that was set into a larger flat box also filled with rich soil, the roots penetrating through cracks. The object was to see if by the most careful treatment this plant could be induced to produce more of the fasciated fruits. In early winter many flowers appeared with six to ten petals, and then some with many petals and fasciated pistils. It was soon found that such fasciated flowers did not readily close-fertilize, on account of a lack of pollen, and most of the early ones dropped off, as there were no insects in the house. The later ones were therefore hand fertilized by pollen from other flowers of the same plant.

Besides 2-, 3-, 4-, 5-celled, and fasciated fruits this plant also produced a number of small 2- and 3-celled fruits which were outwardly distinguished by a lighter purplish color and a white area around the tip of the fruit, which was more pointed than usual. These were called "White-tipped" fruits. When dissected these fruits invariably showed near the tip of the fruit, entirely enclosed by the fruit skin, a spherical greenish-white envelope (calyx?) enclosing parts similar to corolla, stamens, and pistil of normal flowers. (See Plate XXIX.) Some of these fruits were seedless, while others contained as many as 20 perfect seeds.

The Prairie Berry bears its crop in irregular overlapping periods. When a certain number of fruits are set (the number depends on strength of plant and favorable conditions), flowering ceases; when these fruits are mature or are picked off, new branches arise and the flowering is renewed. Whenever flowering had thus stopped, the picking of the crop was begun. As only ripe fruits were taken there were two or three harvests in each fruiting period. The result of the crops produced in the greenhouse in winter were as follows:

April 8 picked 334 fruits.

2-celled—78.1%; 3-celled—20.7%; 4-celled—1.2%; Fasciated dropped off as flowers.

April 12 picked 76 fruits.

2-celled—72.4%; 3-celled—19.7%; 4-celled—0; Fasciated—6.6%; White-tipped—1.3%.

April 20 picked 106 fruits.

2-celled—66.0%; 3-celled—11.3%; 4-celled—3.8%; Fasciated—4.7%; White-tipped—14.2%.

May 17 picked 253 fruits.

2-celled—70.9%; 3-celled—22.7%; 4-celled—1.6%; Fasciated—0.8%; White-tipped—4.0%.

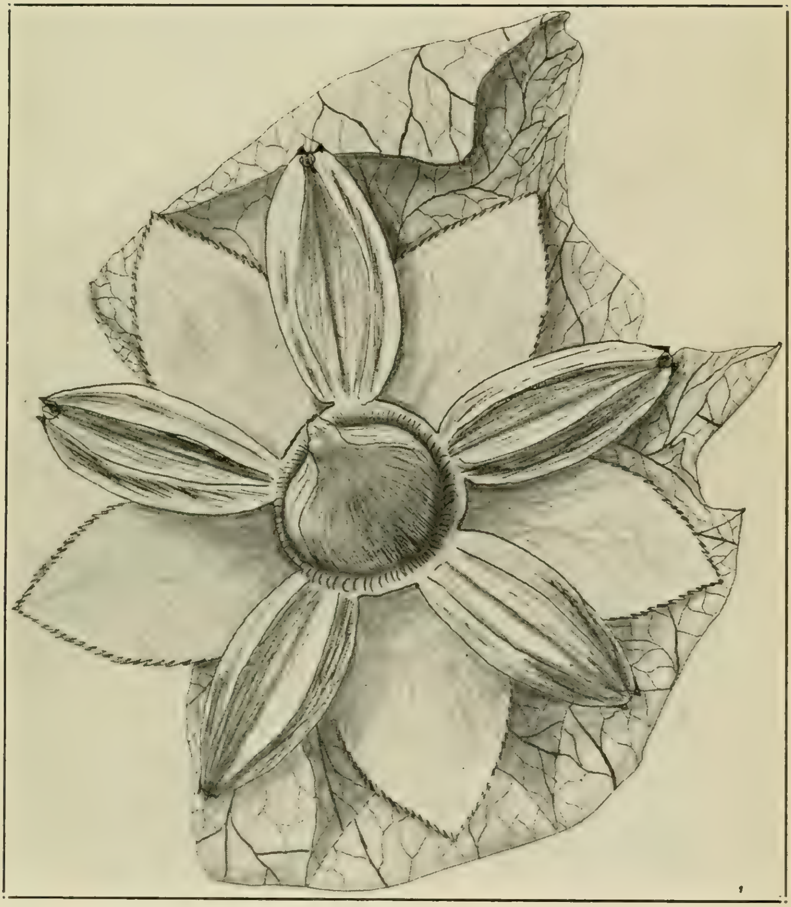


Plate XXIX. Dissected Capsule from the interior of a "White Tipped" Prairie Berry.

This makes the total percentages for the greenhouse crop of Plant 1—

2-celled—73.5%; 3-celled—20.0%; 4-celled—1.6%; Fasciated—1.5%; White-tipped—3.4%.

The fasciated fruits were preserved for seed and numbered Ft. 1, Ft. 2, etc. One 2-celled fruit and one White-tipped fruit were also seeded for a later experiment.

On May 17th Plant 1 was carefully transferred to the breeding grounds with as little disturbance of the root as possible. All branches were cut back to about three inches above ground. Numerous small branches appeared, and the plant made no attempt to send out upright shoots, but assumed a different aspect.

On August 3 picked 524 fruits.

2-celled—59.73%; 3-celled—34.92%; 4-celled—2.67%; 5-celled—0.57%; Fasciated—0.96%; White-tipped—1.15%.

September 5, picked 135 fruits.

2-celled—69.63%; 3-celled—28.15%; 4-celled—2.22%.

October 27, picked 77 fruits.

2-celled—39.0%; 3-celled—55.8%; 4-celled—5.2%.

This makes the total percentages for the field crop of Plant 1—

2-celled—59.4%; 3-celled—35.9%; 4-celled—2.8%; 5-celled—0.4%; Fasciated—0.7%; White-tipped—0.8%.

Thus, during its first year Plant 1 gave a total of 66.4% of 2-celled fruits (the normal) as against 33.06% of other fruits. The ratio of $\frac{\text{2-celled fruits,}}{\text{other fruits,}}$ is then, very nearly as 2:1.

The following fruits of Plant 1, ripened in the greenhouse, were selected for seed, and a number of plants from the seeds of each fruit planted in the summer of 1910.

Fruit 1 fasciated, 5-celled—11 plants.
" 2 " 4-celled (solid center)—18 plants.
" 3 " 5-celled (broken center)—20 plants.
" 5, a double fruit, one-half 2-celled, one-half 4-celled, only the 2-celled portion had seed,—15 plants.
" 7, 4-celled—20 plants.
" 8, 5-celled— 8 plants.
" 9, 3-celled—21 plants.
" 12, 3-celled— 5 plants.
W. T., white tipped fruit—6 plants.
2c, 2-celled fruit—18 plants.

Plants of fruits 1, 2, 3, 7, and W. T. were set out in June in Strip 3 in rather poor red shale soil. They suffered much from the drought and an attack of flea beetles. All ripe fruits were taken off successively on September 5, September 26, and October 13. The plants from fruits 9, 12, and 2c were set out in July, after heavy rains, in Strip 3 also. All their fruits were harvested at one time, October 13.

The plants from fruits 5 and 8 were set out in July, before the rain, in the Home Grounds, on good soil. Their entire crop was harvested on October 10.

Separate data were kept of the exact number and percentage of 2-, 3-, 4-, 5-celled, fasciated and white-tipped fruits on each plant, embodying the records of 142 plants and about 50,000 fruits. These data show that the individual plants grown from seed of the same fruit, which was fertilized within the plant, show wide variation in the percentage of 2-celled fruit they produce. These variations are shown by these figures:

PERCENTAGE OF 2–CELLED FRUITS IN PLANTS OF:

Parent Fruit.	Lowest.	Highest.	Average Plant.
Fruit 1 (5-c.)	45.6	73.4	60.05
W. T. (?)	30.8	75.0	60.95
Fruit 3 (5-c.)	43.8	77.5	63.0
Fruit 2 (4-c.)	22.0	80.9	63.1
Fruit 7 (4-c.)	37.7	80.0	63.6
Fruit 8 (5-c.)	53.6	75.2	64.7
Fruit 5 (2 +4-c.)	28.4	77.6	66.1
Fruit 2-c. (2-c.)	62.8	89.5	73.2
Fruit 9 (3-c.)	40.0	86.7	73.3
Fruit 12 (3-c.)	73.7	83.6	77.3

While these figures are in no way conclusive as showing a direct heredity of high or low percentage of 2-celled fruits, it will be noted that in general the 5-celled fruits led with lower averages for 2-celled fruits, while the 2- and 3-celled fruits had the highest averages. Neither fruit 12 nor the 2c fruit produced a single plant recording below 60.05, i. e. the average of Frt. 1, and fruit 9 produced only two out of 21. Seed was saved from the plants of Frts. 1, 7, 12, and 2c, and work will be continued on this subject.

It is seen then that the 2-celled fruit did not in this case produce in its offspring the greatest average of 2-celled fruits, though it did produce the highest registering individual, with 89.5%. Similarly, we find that the highest average of 3-celled fruits was furnished by the offspring of W. T., followed by Ft. 1, a five-celled fruit; the highest average of 4-celled fruits by Frt. 2, which was 4-celled; of 5-celled and fasciated fruits by Frt. 5, a double fruit. The total number of fasciated fruits produced was 53; the highest average 0.9% by Plant 7 of Frt. 7.

Estimating the total number of fruits of the original plant bearing the first fasciated fruit found at 1,000, the one fruit would give us 0.1% fasciated fruits, followed by Plant 1, raised under the most favorable conditions, with a percentage of 1.1, and its best offspring under very unfavorable conditions, with .9%.

A similar parallel experiment was conducted in the greenhouse. The seeds from a 2-celled, 4-celled, and an 8-celled fruit of Plant 1 were sown in separate boxes and some of the seedlings transplanted into other boxes and given plenty of room and care. From the very beginning the plants grown from the 2-celled fruit were much weaker and smaller than the others, while those from the 8-celled fruit were the most robust. No fruit over 4 cells was produced. The percentage of 2-, 3-, and 4-celled fruits by offsprings of the different fruits were as follows:

Parent Fruit.	Aver. % 2-celled.	Aver. % 3-c.	Aver. %4-c.
8-celled	42.6	48.6	8.85
4-celled	51.4	40.1	8.40
2-celled	66.35	29.6	4.0

While these averages seem very consistent and instructive, the variation in the individual plants was so great that they cannot be considered conclusive.

A curious fact was brought out in those plants which were harvested at different intervals. Of 44 plants for which records were taken for the three harvests of September 5, September 26, and October 13, forty-two show the highest percentage of 2-celled fruits in the last crop; thirty show the lowest percentage of 2-celled fruits in the middle crop, and fourteen in the first crop. The percentages in the different crops vary quite as much as those for different plants.

From the foregoing it is evident that the fluctuation within the individual at different periods, the variation of fluctuation in different offsprings of the same parents, and the variation in fluctuation possibly due to differences in their parents, should be studied separately, to arrive at any sound conclusions.

A Study of the Heredity and Correlation of Structures in Tomatoes.

REPORT OF PROGRESS.

The ten types of tomatoes known as Currant, Cherry, Plum, Pear, Fig, Peach, Dwarf, Potato Leaf, Ponderosa and Oligosperm are being studied microscopically as to the nature of their differentiating structures. The results of the study of their fruit skins were published as Bulletin 228, and similar work is under way on characters of leaves and stems.

Crosses were made in the greenhouse, in the winter of 1909-1910 between all of these types, excepting the oligosperm, which could not be crossed with any other type. They resulted altogether in 36 fruits of the possible type combinations, with 33 of their reciprocals, and 15 alternatives, i. e. combinations of different fruit colors of the same types. Besides there were 21 duplicate or triplicate fruits. All the seeds of all except a few triplicate fruits were sown in rows in boxes in the greenhouse and the seedlings studied minutely as to fluctuation in the shape of the cotyledons and first leaves, and compared with the fluctuations of seedlings of the parents. Then the plants, a total of about 5,600, were set out, two and three in a hill on fourteen plots of the Home Grounds and parts of Strip 3 of the New Grounds.

In this F_1 generation a study was made of the heredity of the habit of the plants, the size of the stem, size and shape of leaf, hairiness, size, color, shape, and cell number of fruit, form of cluster, and number of flowers to the cluster. All the data were obtained by measurements and counting of large numbers. Specimens were preserved for later microscopic study.

Many self-fertilized fruits were obtained from each set of crosses for the next generation.

The details of the experiment will appear shortly in form of bulletins. It was possible to confirm the fact that the color of fruit skins exhibit in the F_1 complete dominance, and it was apparent that

1. There is in the F_1 of tomato hybrids no apparent dominance of size or shape, of stems, leaves or fruit.

2. Reciprocal crosses between the identical parent plants may give different characters in the two sets of F_1 plants.

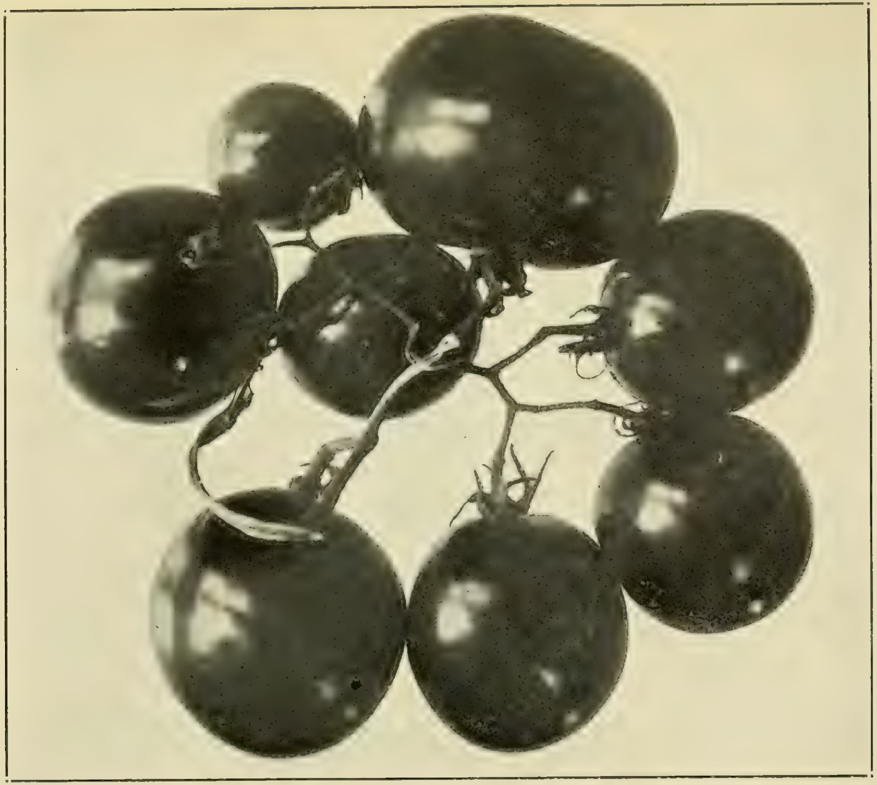


Plate XXX. A cluster of long and flat fruits from F_1, of the cross of the "Pear" tomato and the "Ponderosa."

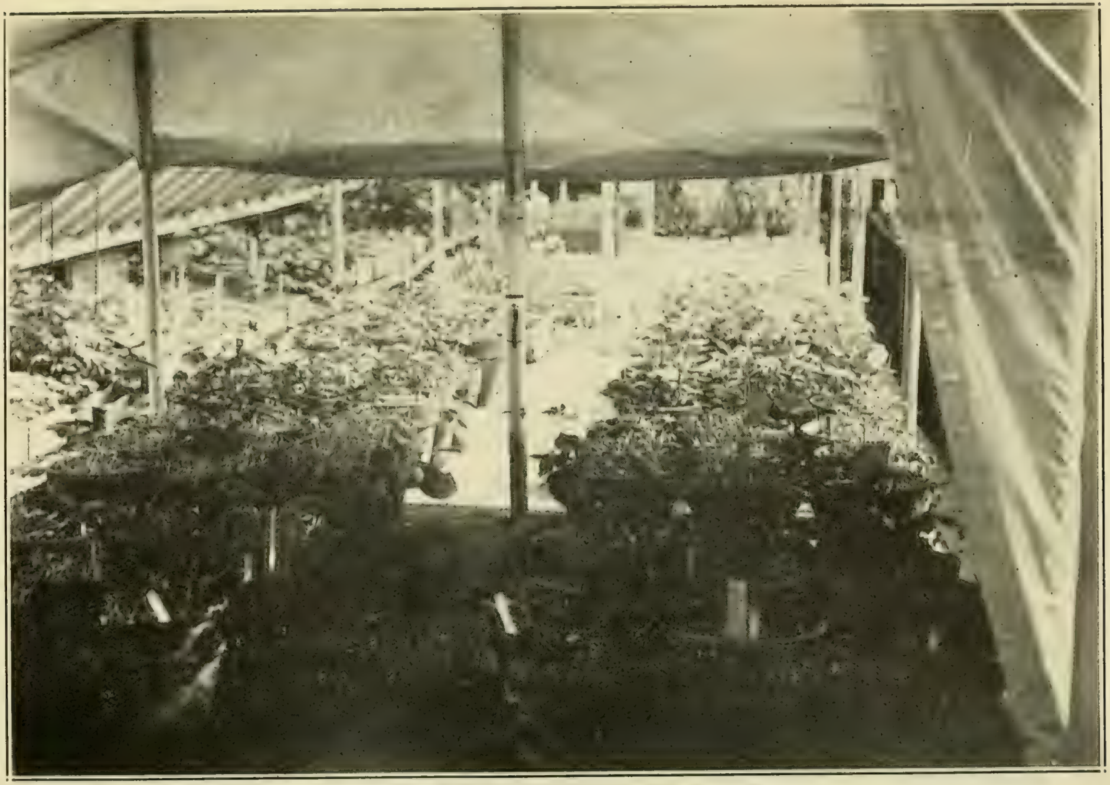


PLATE XXXI. *Arrangement of Shade Experiment.* Back of tent raised for taking picture.

3. Shape of fruits may be inherited in a different manner among plants grown from the seeds of the same handworked fruit.

4. The F_1 generation of a cross between a tomato with a very long fruit ("Pear") and a tomato with a very flat fruit ("Ponderosa") may show on the same plant, or even on the same cluster, fruits which are longer than broad and others which are broader than long. (See Plate XXX.)

Shade Experiments.

REPORT OF PROGRESS.

It has long been known that in darkness and shade different plants behave in entirely different ways. In some shade greatly changes the shape and size of the vegetative organs, in many it greatly interferes with the reproductive faculties, while in others it inhibits their activity altogether. Still there are many plants in which either the shape or the size of leaves and stems are not greatly changed, or in which flowering and fruiting may go on in an almost normal way.

The following is the report of a preliminary experiment conducted in the greenhouse during the summer of 1910, which was to serve as a guide for the selection of material and suitable conditions for a larger field experiment.

A section of the central bench of the greenhouse, bounded by uprights 7 ft. apart each way, was transformed into a tent by covering the sides and top entirely with heavy white canvas (See Plate XXXI). Thirty-six 10-inch pots inside of the tent and the same number outside on the bench were filled from the same pile of well mixed fertile soil and planted on June 3rd with seeds of *Extra Early Valentine Bean, Early Curled Silesian Lettuce, Giant Crimson Globe Radish, Red Currant Tomato, Yellow Peach Tomato and Crimson Cushion Tomato.*

Notes were taken on time of germination, flowering, fruiting, comparative rate of growth, etc. On June 28 all plants were pulled up for individual measurements except that in both tent and control lots there were retained four pots with beans, four with lettuce, four with radishes, and four with the three types of tomatoes mixed. The remaining five lots of four pots each were planted with *Triumph Sweet Corn, Arlington Cucumber, White Mustard, Bryophyllum* and *Kochia scoparia.* Notes were taken as before until November 28, when samples of all plants were preserved for microscopic study.

It was found that the beans were able to complete their entire life history in the canvas tent shade and ripen fruits. The seeds differed in no apparent characters from those of the control plant. The cucumbers flowered freely, but produced only male flowers. None of the other plants flowered in the shade. In the case of the beans the first open flower and the first ripe fruit were reported on the same day for both shade and control plants.

It appears from the measurements taken after June 28 that in the seedlings of all plants under observation the hypocotyl averaged longer in the shade than in the sun (number of plants varied from 105 to 700). Beans and radishes grown in the shade averaged a greater total height than the controls, but control tomatoes averaged higher than shade plants; the length of the lamina of the leaf was less in the shade plants of radishes, lettuce, and tomatoes, while unchanged in the beans. The width of the lamina was less in the shade radishes and lettuce, but unchanged in the beans. The length of the petiole was decreased in the shade tomatoes, increased in the shade lettuce, and left unchanged in the bean. The number of leaves in the plants was the same in the beans, but less in the shade plants of lettuce, radishes, and tomatoes. (See Plates XXXI and XXXII.)

In the older plants it was noted that in all plants excepting the beans and Bryophyllum growth soon became much slower in the shade plants, so that the shade seedlings which had appeared taller the first few days, on account of their longer hypocotyl, soon were outgrown by the controls. In all cases stems, leaves, and petioles of shade plants were thinner.

Among the plants put in later the corn differed from its control by the successive shortening of the upper internodes, which is exactly the opposite of what happens in the normal plants. The Kochia plants, which had developed a few short branches when transplanted, became large much-branched bushes in the sun, but developed no more branches in the shade and grew at a very slow rate.

The four Bryophyllum plants are now (November 22) still about as tall as the controls, but darker in color, with thinner stems and smaller leaves. (See fig. 1, Plate XXXIII). They have so far failed to develop compound leaves, which in the controls appeared in the 7th and 8th leaf above ground.

None of the radishes developed any storage roots in the shade, though most of the control plants ran through their entire life history of producing large roots, flowering, and maturing seed. In beans, cucumbers, Bryophyllum, the shape of the leaves was not changed. Little changes took place in the shape of tomato and

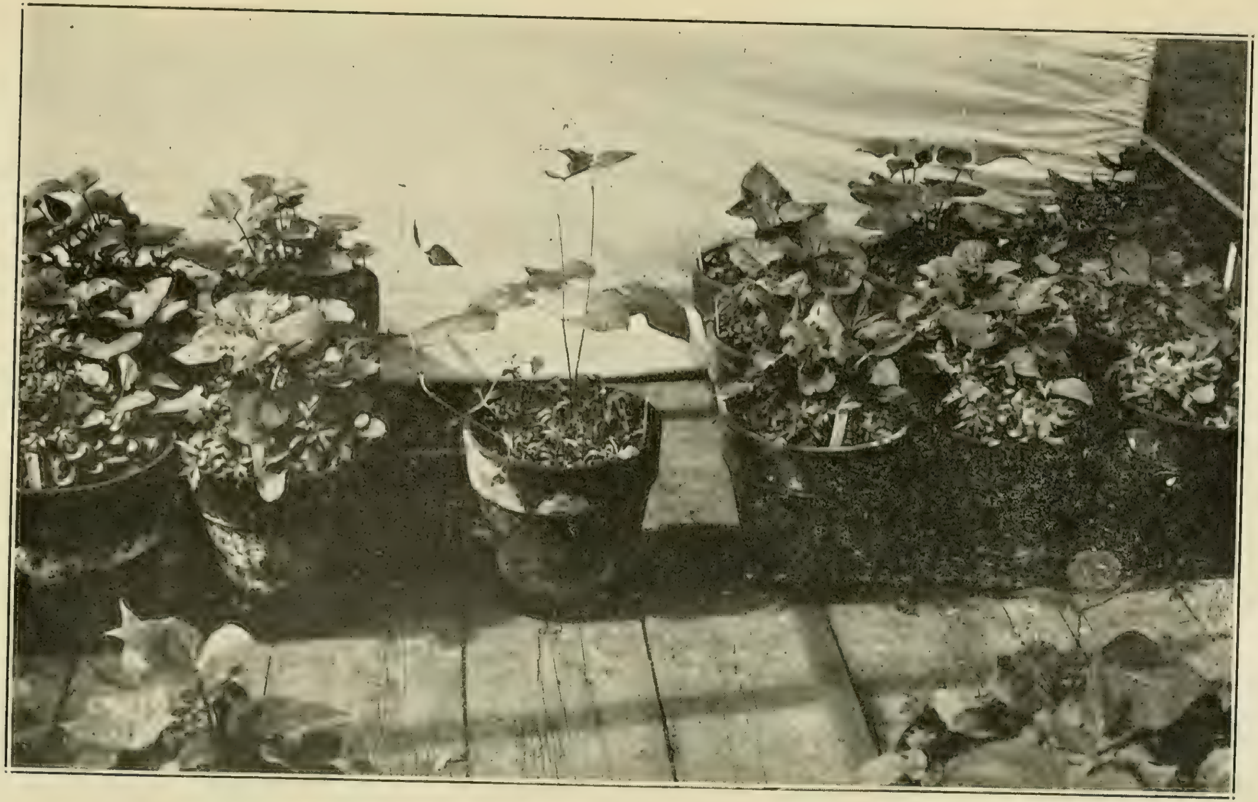


PLATE XXXII. *Shade Experiment.* Seedlings 25 days old; center pot from shade.

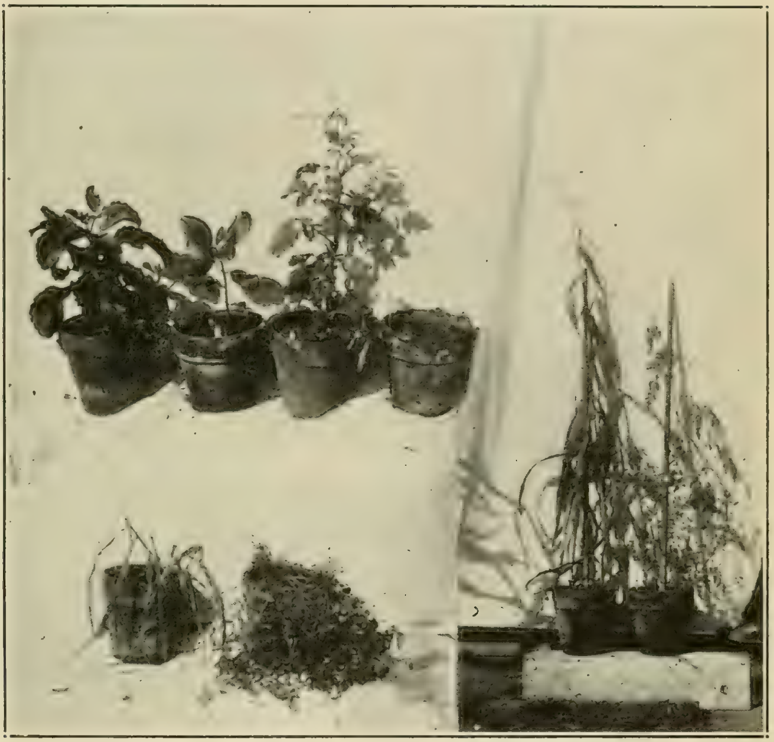


Plate XXXIII. Shade and Control Plants of Bryophyllum, Radish, Corn and Tomatoes.

mustard leaves, but great changes in the leaves of lettuce and corn. The corn leaves became much narrower in comparison with their length, while the lettuce leaves became long-stalked with small lamina.

Search is being continued for plants which will lend themselves well to such experiments. It seems so far that beans, Bryophyllum, radishes, Kochia, and corn furnish good examples of different effects of shade; but all except beans and Bryophyllum suffer too severely in the shade. An effort will also be made to devise some way of standardizing and controlling the actual degree of shade.

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